THURSDAY, DECEMBER 29, 1870

SCIENCE AT SCHOOL BOARDS

THE country may, we think, be congratulated on the election of School Boards in London and the provinces. Although from our point of view it may be deplored that so few men of Science, or persons having any pretension to understand what Science means, have been elected, it must be felt that the beginning of a great work has taken place in this country, the end of which no one can at present foretell. The nation, for the first time in its history, has taken the subject of education into its hands. The Education Act will be open to alteration and revision in the Houses of Parliament, and from step to step we may hope to see at last a department of Government representing the wishes of the people, dealing alike with the education given in our universities and our ragged schools. The great aim of the country must be to give to every child born in the kingdom the best education adapted to secure its happiness and usefulness in this world. There is no doubt that this will be the feeling that will prompt members of the various School Boards to carry out the powers which have been given under the Education Act.

We exceedingly regret that the various Boards have been elected rather upon a religious ground than upon the general principle of what is desirable to be taught in the schools. As we read the Act, there will be little opportunity left to the Board to increase or alter the conditions of "religious teaching" in any of the schools. It would have been better, perhaps, to have excluded all religious teaching from the primary schools, on the grounds, first that the feeling of respect and even awe which ought to attend the teaching of the Bible, is likely to be diminished by making it a common reading and task-book in schools; and secondly, that the clergy of the Established Church and of the various denominations, who are amply paid for their religious ministrations, ought especially to undertake religious teaching, and conduct it under circumstances that would render it most efficient and useful in the moral training of a child. There is also a third objection, and that is that the rate ought not to take the money of one set of people for the purpose of teaching the religion of another. There are certain moral obligations underlying all the higher religious creeds, to which no parent could possibly object, which ought to be taught and insisted on everywhere in universities as well as primary schools.

With regard to the other subjects to be taught in the schools, we would call attention to the danger there is that any extension of the means of education should lead to an imitation of the system now in existence. That system consists almost entirely of giving lessons out of books and teaching children words independent of the facts they represent. The present Chancellor of the Exchequer has well said, "I think it is more important for a man to know where his liver is seated and what its functions are, than to know it is called *jecur* in Latin and ἧπαρ in Greek." Of course there is no chance of Latin and Greek being introduced into our primary schools, although if they are such a precious means of developing the mind as they are assumed to be, there seems to be no reason why they should not. But the substitute for these branches of human acquirement is found in our lower schools in the shape of reading poetry, history, geography, and the like. If the sentiment of the Chancellor of the Exchequer exists in the new School Boards, the time seems to have come when some effort may be made to give up a certain amount of time in all schools to the teaching the facts of the external world. This is what is usually called scientific training, and has been almost universally regarded in our systems of education as something that may be dispensed with. But Science is after all but a systematic arrangement of observed facts by which the laborious investigations of the few may be made the possession of the many.

It may be urged in favour of this teaching that it educates (draws out) portions of the mind which cannot be cultivated by means of words and figures or moral lessons. A boy may be able to read all languages and master all problems in mathematics, and be a moral paragon, and yet commit some stupid blunder, from ignorance of some obvious chemical, physical, or vital law, that may cost him his life, or, what is more important still, may lead to the death of others. Our whole national history is full of terrible instances of punishment for breaking obvious and easily understood natural laws.

That Natural Science can be taught in schools there is no doubt. It has been introduced in a limited way into our great schools, as Harrow, Rugby, and Eton; and, so far as it has gone, it has not only not been attended with any diminution of acquirements of other branches of knowledge, but rather the contrary. In some of the national schools in Ireland, Science has been introduced, and we can bear testimony to the amount of useful information acquired by a class of boys in chemistry at the National School in Sligo.

The most difficult question for the School Boards to determine will be how to begin. In nine cases out of ten they have no men of Science to direct them. There is one comfort in London, that the Board will have a host in Professor Huxley, who, if they will listen to him, is undoubtedly capable of giving good advice. He will be ably backed by Miss Garrett, who, with her medical education, will be fully able to appreciate both the subjects and methods of any attempt to teach Science in our schools. Mr. Lucraft, the working man's candidate, has also advocated the teaching of Natural Science in schools. If the other candidates said anything on this subject, the reports of their speeches have not yet reached us. Still we may hope and we would especially recommend to the reading of all members of School Boards a "Report of a Committee appointed by the British Association on Scientific Education in Schools." It is a parliamentary paper, published in March 1868. We do not think this paper had the attention paid to it demanded by its intrinsic importance; and we are glad to recommend it, as especially adapted for the reading of members of School Boards and of all interested in education.

Without having any cut and dry system to offer to the public, we would advise that some attempt be made to teach some quantum of Natural Science somehow. The present masters will probably be utterly ignorant of any branch of Science, but there are plenty of students of Science who would undertake at first to instruct, perhaps in several schools. They should be instructed to teach

children to observe facts, and lead them gradually from simple facts to the more obvious and easily understood laws of Science. Such classes are formed in Germany, in what are called *Real Schule*, and the system has been introduced into England under the name of Object lessons. Such teaching might be preparatory to taking up any one branch of Science, such as Chemistry, Experimental Physics, Botany, or the elements of Human Physiology.

We are glad to find that this subject has again been taken up by the British Association for the Advancement of Science. A few days ago a deputation of this Association waited on the Vice-President of the Council for the purpose of presenting a memorial on scientific teaching in elementary schools. Their reasons for urging this subject, they say, are three : "Firstly," the memorial says, "we conceive such teaching to be one of the best instruments of education in the sense of intellectual discipline, and in many respects better calculated to awaken intellectual activity than other studies ; secondly, we think that a knowledge of the elements of Natural Science has a high value as information; and thirdly, we are of opinion that scientific training and teaching in the elementary schools will afford the best possible preparation for that technical education of the working classes, which has become indispensably necessary to the industrial progress of the country." The subjects they propose to be taught are elementary Physical Geography, elementary Physics and Chemistry, elementary Botany, and elementary Human Physiology. They think that by such an education the children of "the poor and necessitous" might be prepared to take advantage of the scholarships and exhibitions which are now only open to the children of the well-to-do classes of society.

E. LANKESTER

THE LEARNED SOCIETIES AND THE PRESENT CONDITION OF SCIENCE AND LEARNING

THE appointment of the Royal Commission on the present condition of Science will naturally turn the attention of many minds to the subject, and its discussion will certainly elicit many suggestions and schemes for the better culture of knowledge. The question is so large, so important, and so difficult, that the freest possible discussion will be necessary for its satisfactory solution.

At present we wish to direct attention to the question as to how we may obtain from the Learned Societies of the United Kingdom the greatest possible aid in the improvement of natural knowledge. The number of these societies is now large. Some of the provincial societies can claim an honourable place even when compared with the associations which are not confined to any one locality in their choice of members. Members of the Literary and Philosophical Society of Manchester, it should be remembered, were the first who were favoured with Dalton's Atomic Theory. Of what we may call the national societies, the number is increasing yearly, greatly to the detriment of real progress. Membership in these societies is coveted because it is supposed to indicate the possession of certain acquirements, it being thought, not unnaturally, that the members have won their spurs as investigators and interpreters of Science. Nor can we conceive of any better tests than those at present applied to candidates. Examinations are clearly impossible in this case, even if one were fully confident of the certainty of that method for detecting ability. It is evident that, on the whole, the regulations now enforced have been successful in their object, and that membership of a British Learned Society is generally not only a coveted distinction, but one deservedly prizeable.

Year by year these societies gather up the result of patient investigations, of long and careful research. Recording new facts, illustrating old truths, dissecting error, they pursue a course of steady consistent usefulness. Every one who has had to work up some special topic, must have a feeling of gratitude for the aid he has received from their publications. The societies are doing a good share of honest work, and doing it well. Their ranks include the most distinguished and the most ardent investigators in each branch of learning. Still we need not attempt to disguise the fact that they do not contribute so largely to the advancement of knowledge as it is desirable they should do. They have forgotten, or never known, that unity gives strength. They have neglected the great fact, daily becoming more apparent, of the unity of knowledge.

"The divisions which we establish between the Sciences are, though not arbitrary, essentially artificial. The subject of our researches is one : we divide it for our convenience, in order to deal the more easily with its difficulties. But it sometimes happens—and especially with the most important doctrines of each Science—that we need what we cannot obtain under the present isolation of the Sciences,—a combination of several special points of view ; and for want of this, very important problems wait for their solution much longer than they otherwise need do. To go back into the past for an example: Descartes's grand conception with regard to analytical geometry is a discovery which has changed the whole aspect of mathematical science, and yielded the germ of all future progress ; and it issued from the union of two Sciences which had always before been separately regarded and pursued." (Comte.)

Science suffers not only from the causes indicated in the preceding extract, but also from the dispersion of material in different receptacles, all of which are not accessible to the student. If the number of existing learned bodies be taken into consideration, and also their conflicting claims, it will be obvious that none except rich men can possess all the aid which they can give to the investigator. A paper upon the characteristics of one of our English dialects might appropriately be read before the Royal Society, the Society of Antiquaries, the Philological Society, the Archæological Institute, the Archæological Association, the Royal Society of Literature, the Ethnological Society, the Anthropological Society, and a score or more of the provincial societies. We find a valuable monograph on the Lancashire dialect in the Proceedings of the Philological Society, and another in the Transactions of the Literary and Philosophical of Liverpool, but for information on the eastern variety of that dialect, we must go to the Historic Society of Lancashire and Cheshire. The Cheshire glossary must be sought in the Archæologia, the Cumbrian in the Royal Society of Literature.

The same confusion may be predicated of almost every subject that can be taken up for inquiry. And, in spite of the multiplicity of societies, there is greatly needed throughout the length and breadth of the land a network of intelligent observers. We propose, as a remedy, that the present chaotic want of system be superseded by a National Institute for the Advancement of Knowledge. Such an institute might readily be obtained by the amalgamation of the present societies into one homogenous body. Whatever of interest and of value British savants might bring before it would be welcome and appropriate, and would be accessible to the student of the "knowledge which is one." In its organisation, the first labour would be the classification into sections. Whilst, on the one hand, there would not be three or four sections to perform the same work, on the other hand the entire domain of human knowledge could be fairly occupied, which is not the case at present, and the divisions marked with much greater accuracy than is now possible. The members residing in each district would form a local section, hold their meetings at regular intervals, and be a committee charged to watch over and promote the interests of Science and Learning in their particular neighbourhood.

In this brief and necessarily imperfect outline, much is omitted. Advantages not here indicated would result from the creation of a National Institute for the Advancement of Knowledge, but it is hoped that enough has been said to prove the desirability of such a foundation, having for object the attainment (in the words of Bacon) of "the knowledge of causes and secret motions of things; and the enlarging of the bounds of humane empire to the effecting of all things possible."

WILLIAM E. A. AXON

PROF. BALFOUR STEWART'S ELEMENTARY PHYSICS

Lessons on Elementary Physics. By Balfour Stewart, LL.D., F.R.S. (London: Macmillan and Co.)

THIS is a bold experiment, and decidedly deserves to be a successful one. Nearly all our elementary works, even on mere *departments* of Physics, are extremely bad, especially the so-called "original" ones; and those which have been translated from the French are little suited to the genius of this country—however excellent they may be in France—while they are usually spoiled by inaccurate translation, or by clumsy and injudicious addition of a mere cobbling or patching kind.

The reasons are not far to seek. It is very rarely that we find in this country a genuine scientific man who can, like Faraday or Herschel, make himself easily intelligible even on difficult subjects to an ordinary reader; still more rarely that we find such a man to have paid such special attention to the merest elements of his subjects as to thoroughly understand them himself, which ought to be regarded as an absolutely indispensable preliminary to his teaching them to others. Take for instance the question of the measurement of temperature in conjunction with the second law of thermodynamics, that very second law itself, or its connection with the equality of radiating and absorbing powers. Take even a simpler matter, the notion of a standard pound as a definite quantity of matter, not as something which shall be attracted by the earth with a certain force. Try all the elementary works in succession, and, if you are not driven mad by their inconsistencies and want of definiteness, endeavour to give in a clear, intelligible form the result of your studies on any such questions as those just mentioned. If you had no notion to begin with, you will have none, or worse than none, at the end; and, even if you began with thorough knowledge, you would probably end helplessly confused, doubting the simplest and most obvious truths. But this is the way we do things at home; and hard, indeed, must be our British heads, which, after they have managed our "*As in præsenti*," &c. &c., can plunge into this further chaos, and rise, as they often do, refreshed and invigorated by the struggle. A Frenchman, perhaps even a German, would perish in the attempt. But for them the path is made comparatively easy.

Nothing seems plainer than this—that he who has been ill-taught in the elements of his subject, however he may advance in knowledge (which is always a man's *own* work, whoever be his teacher), can hardly hope to understand these elements well enough to teach them to others. They have become to him a hateful thing, so he pushes on and avoids them as much as possible. Hence, that we may have really elementary works of a strictly scientific kind, we must have, not merely a genuine scientific man to write them, but one whose elementary instruction was good, or one whose strength has enabled him to get over its imperfections. These qualifications are certainly united in Dr. Stewart, for he had the late Principal Forbes for his teacher, and he is himself a man of quite exceptional powers, both in experiment and in reasoning.

It is scarcely possible to form a judgment as to the probable success of the present work. It is so utterly unlike anything to which we have been accustomed, that we can only say we never saw such a work, in English, at all events. Nothing so perfectly elementary, and yet throughout so intensely suggestive, have we ever met with. Even while reading the introductory chapters, we have several times laid down the book to follow trains of reasoning suggested by a single happy phrase that showed us something with which we had considered ourselves familiar, from a perfectly novel and interesting point of view. This, of course, will not strike the beginner, neither will it impede his progress; for it is not learned and abstruse disquisition or discussion, it is simply the clear vision of the writer.

Dr. Stewart does us much more than justice in the Preface, for he exaggerates the importance of a few suggestions of ours, made only with the view of keeping him to *his own plan*, which we consider to be an admirable one. The grand modern ideas of Potential and Kinetic Energy cannot be too soon presented to the student; he ought to be familiarised with them as soon as he commences the study of Physics. In fact, we believe that before many centuries have passed, perhaps before fifty years have elapsed, the word Force will have become as much a nuisance and an impediment to the beginner in Physics as the phrase Centrifugal Force is already.

However this may be, the work before us is an excellent one, and will certainly (*if there be teachers found sufficiently*

instructed to recognise its merits, and sufficiently humble and enterprising to stoop to learn anew, and by a better method, the elements of their science), take its place at the head of elementary treatises on its subject. It is by no means faultless: no first edition on so new a plan could quite avoid confusion; there is excess of detail on many points, too little on others, and the language, though generally correct throughout, is sometimes almost mystical. This is not a reproach—quite the reverse—for it is mainly in these passages that we feel the strength of the author, and we are unfortunately not speaking from the beginner's point of view. He has evidently thought deeply, and the result is in all cases well worthy of careful study, especially for those who think themselves thoroughly masters, if but of the merest elements. No one can read the work without feeling that he has still something to learn, even in the most prosaic parts of the science. Dr. Stewart does not, as it were, follow the ordinary laws of war; he abjures pipe-clay and red tape, and he has a method of his own which we cannot but think is calculated to do a real service to the beginner. Even methods in mathematics cannot be stereotyped; Euclid is about to be laid on the shelf; and it is not at all unlikely that in a few years the so-called Cartesian x, y, z, will disappear, to make way for Hamilton and his vectors. Thus it is, and shall be, with the so-called *statical* proofs of the Parallelogram of Forces, we shall get back to Newton's methods as nearly as modern nomenclature will permit; and so likewise in other parts of physics. The reign of *inartificiality* and *simplicity* must soon be inaugurated, and this work will greatly tend to hasten its advent.

It would be improper to finish without finding some additional fault, especially after all we have said in praise of the work, and even Dr. Stewart's recent accident (from the effects of which we are delighted to hear he is steadily recovering) must not influence us.

The printing is excellent; but some of the woodcuts (the balance, p. 59, and the strained beam, p. 71, for instance) are not merely execrable, but, what is far worse, misleading. No mention is made of the Peltier effect at a thermoelectric junction, nor is Sir W. Thomson's so-called "specific heat of electricity" alluded to, though both might easily have been introduced without increasing by more than a page or so the bulk of the volume. These are matters of such fundamental importance, and are capable of such easy description, that they certainly ought to have been given. There are other points of a similar kind, but it is not necessary to mention them.

Dr. Stewart very fully treats of the grand question of the equality of Radiation and Absorption, the question which first brought him prominently before the scientific world; but he has done it with such an excess of modesty that his own genuine claims might be endangered, were there not happily other works in which his services to this important branch of science are fully recognised.

It is peculiarly sad that Prof. Stewart should have been temporarily disabled just when he was getting into working order his Physical Laboratory in Manchester: no one is better fitted for such work than he is; let us hope that he may soon be in a position to resume the direction of it, and to teach beginners by means of his excellent Manual.

P. G. TAIT

OUR BOOK SHELF

The Academy. Vol. I. (London: Williams and Norgate. 1870.)

WE congratulate our twin brother (or sister?) the *Academy*, on the appearance of its first volume. The journal had at its starting a clear *raison d'être*, to respond "to a widely felt and constantly expressed dissatisfaction with the existing organs of literary and scientific criticism." The wide field embraced in the programme has rendered the editor's task anything but an easy one. Of the literary department it does not come within our province to speak; the scientific portion, we can fairly say, has been honestly and ably executed. This department consists of two sections—original reviews, and scientific notes. The former, in accordance with the practice of the rest of the paper, are all signed. The desirability of signed articles is one that has been much debated. Whatever may be its relative advantages or disadvantages in literature or politics, we are convinced that in science the former greatly outweigh the latter. In reading a criticism on a scientific work, it is before all things necessary that we should know that the critic has a right, from his own knowledge of the subject, to speak with authority. The signatures to the scientific articles which will be found in this volume are themselves sufficient guarantee that the subject is discussed from a standpoint from which something is to be gained by the reader. The scientific notes consist of paragraphs under the various heads of chemistry, physics, geology, zoology, botany, physiology, &c., epitomising the most important discoveries or researches of the month. Though the subjects are rather unequally treated, the notes have evidently been drawn up with great care by competent men, and the whole gives a very fair *résumé* of the more important advances in each department of science. If we might mention one section that appears to us to have been particularly well done, it is that of physiology. A list of the new books of the month, English and foreign, is also given, and the titles of the more important scientific magazine articles, with occasional abstracts of them. We notice with pleasure the conscientious manner in which the editor invariably acknowledges the source of his information, a practice we could wish to see more generally carried out by his brothers of the craft. Other literary journals have been content hitherto to supply their readers with their modicum of science either second-hand and very much out of date, or with a disregard to accuracy which has rendered it perfectly valueless. The *Academy* is doing good service in bringing scientific subjects before educated readers who have no special scientific bias, in a style that is likely to interest them in it, and in a manner that may be relied on as sound and accurate, and calculated to increase the knowledge in which they are, as a rule, so lamentably deficient.

Die Praxis der Naturgeschichte. Zweiter Theil: Dermoplastik und Museologie, oder das Modelliren der Thiere und das Aufstellen und Erhalten von Naturaliensammlungen. Unter Mitwirkung von Präparator Bauer, Prof. Dr. G. Jäger, Stadtdirektions Arzt Dr. Steudel, und der Thier- und Landschafts-Maler, Paul Meyerheim und Friedrich Specht; von Philipp Leopold Martin. 8vo, pp. 240, six plates. (Weimar: B. F. Voigt. London: Williams and Norgate 1870.)

FEW tasks are more distressing to a right-minded naturalist than the inspection of the ordinary mounted specimens of animals in most museums in this country and elsewhere. More hideous spectacles than usually meet one's eyes when visiting these establishments it is impossible for man to form, or mind to imagine. Some little advance, it is true, has been made of late years, upon what was formerly the prevailing type of a "stuffed beast." But no real reform can take place until the curators of museums have come to recognise the great

truth, that, unless such objects are properly mounted, it is worse than useless to exhibit them to the public at all. They should be taken down and stowed away in drawers, or preserved in any other way that may be convenient for scientific study. Left in their glass cases, they are much more likely to repel than to attract the ordinary observer, for whose benefit the exhibition is intended.

Under such circumstances we cannot receive otherwise than with pleasure a treatise prepared with the view of teaching the true principles of the art of taxidermy and their proper application. The Royal Cabinet of Natural History at Stuttgart is well known to those who have visited it as one of the few institutions of this kind where real care and skill are exhibited in the mounting of the specimens, and no one can be more fitted than its energetic "*preparateur*" to give instructions upon a subject of which he has shown such perfect knowledge. Herr Martin has, moreover, obtained the assistance of several individuals who are fully qualified to assist him in his task, which appears to have somewhat of a comprehensive scope. In a former part of the present work, Herr Martin has treated of the various methods of collecting animals of all sorts in the field, and of preserving them for scientific purposes. The fact of a third edition of this former part having been already called for shows that the work has been appreciated by those or whose instruction it is designed. In the present section of his volume, Mr. Martin and his fellow-workers treat more especially of the processes to be performed in the museum itself, such as the modelling in plaster of beasts large and small, the formation of preparations of the internal organs, the making of skeletons, and the mounting of microscopical objects. Full instructions are likewise given upon every point connected with the practical working of a public museum, not only as regard the objects themselves, and the best mode of exhibiting them, but also in relation to the wants and requirements of the visitors that resort to such institutions.

P. L. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Mimicry versus Hybridity

BEFORE attempting to combat the old theory under which Mr. Murray has taken refuge, in opposition to the theory propounded by Mr. Bates, I must first make a few remarks upon the different forms of mimicry to which the Lepidoptera are subject.

Mimicry may be divided into two heads, viz. :—the mimicry of one lepidopterous insect by another, and the mimicry of the vegetable kingdom, and of backgrounds generally, by Lepidoptera. As Mr. Murray doubtless refers to only the first of these heads when he speaks of hybridisation, I need not trouble the reader with any remarks respecting the second. Mimicry, then, between butterflies and moths, may again be divided into three sections : that which modifies both sexes, that which chiefly modifies the females, and, lastly, that which chiefly modifies the males ;* these variations of modification are all easily explained by the theory of protective assimilation variously adapted to the economy of the different modified species ; but it can in no way be explained by the theory of modification by hybridity. Mr. Murray speaks of hybridisation as if it were a thing recognised by lepidopterists, and of no uncommon occurrence, whereas it has, so far as I know, only occurred in the Heterocerous Lepidoptera, and only between species of the same genus ; there is, indeed, a case on record of a skipper butterfly and a burnet moth being taken *in coitu*, but no reasonable being could expect that any issue would result from such an union ; again, I maintain that if it were even possible for hybridity to occur between different sub-orders, families, or even genera of Lepidoptera (which, by the way, is as likely as hybridity between a vulture and a dove or a horse and a rabbit), the offspring would inevitably be modified in structure just as much as hybrids between distinct races or species of vertebrates are ; they would moreover, if fertile, certainly revert to one or other of the parent stocks, which, however we do not find to be the case ; if the fertilisation of flowers and butterflies were the same, hybrids might be as common in the one case as the other, and the results attained might be more nearly alike ; but as butterflies are not fertilised through the transmission of pollen by external agencies, and as they seem to have a decided preference for mates belonging to their own peculiar species, hybridisation must needs be a thing almost unknown amongst them. Lastly, I need scarcely say that the fact of birds hunting by sight and not by smell only does not in any way destroy the argument respecting the favoured and non-favoured species of Lepidoptera ; the same thing may be said of lizards, frogs, dragon-flies, and spiders, which all of them persecute the order, and which all avoid not those insects only which have a peculiar odour, but those which, like the *Danainæ*, *Heliconinæ*, *Acræinæ*, and others, have an acrid taste resulting from an offensive liquid which they exude from the body. I have been more fortunate than Mr. Scudder, inasmuch as I have frequently seen birds catch and devour the unprotected species upon the wing, whilst I have received abundant evidence both from scientific and non-scientific collectors respecting the perfect immunity which the *Danainæ*, &c., enjoy from all kinds of persecution, whilst their less fortunate brethren come to an untimely end.*

British Museum ARTHUR G. BUTLER

I AM rather surprised that Mr. Andrew Murray should have advanced his theory of mimicry being due to hybridisation, without adducing one solitary fact to prove that hybridisation between distinct *familics* of insects ever occurs, or that, if it do occur, the offspring are fertile *inter se*. Mimicry is most frequent between very distinct *families* or higher groups, and often between different *orders* of insects. We may fairly consider that the "natural orders" of plants, as being the next well-marked groups above genera, are about equivalent to the *families* of insects, so that the analogy furnished by hybridisation among plants, on which alone Mr. Murray's theory is founded, wholly breaks down, unless he can show (which he has not done) that such hybridisation occurs between species of different "natural orders," or of well-marked groups higher than genera. It would be mere waste of time to discuss the details of a theory whose fundamental assumption is not only quite unsupported by fact, but is diametrically opposed to the almost, if not quite, universal fact that hybrids do not occur between species of different families or higher groups.

Mr. Scudder's letter contains some interesting and suggestive facts, and opens up a new field of investigation as to the immunity of certain species, in their egg or larva state, from the attacks of hymenopterous and dipterous parasites. It is, I believe, now stated for the first time, that the peculiar secretions which render the Danaidæ distasteful to birds not only extend to their larva and egg state, but act as a safeguard from the attacks of parasites. The objection that it would have been more advantageous for the larva than for the imago of the *Limenitis misippus* to mimic the *Danais archippus*, appears to me to have no weight. We do not know, for instance, if such mimicry would be any defence against parasites who may be guided by smell rather than sight ; and from the frequent limitation of certain odours and secretions to whole genera or families, the variations necessary to produce them may be of rare occurrence.

The fact that *Limenitis misippus* and *L. ursula* are about equally plentiful is not at all remarkable, since there are species of all degrees of rarity in every extensive group ; but in this case it happens that both insects are mimickers, *Limenitis ursula* resembling the common N. American *Papilio philenor*, especially on the under side, which is exposed when the insects are at rest. This case of mimicry is not so perfect or so striking as the other, but that it is one is pretty certain, and there are several other

* An interesting illustration of this type of mimicry exists between the genera *Belenois* and *Mylothris*, the males of the African group of *Mylothris* being identical in colour with males of the genus *Belenois* (sub-family Peirinæ).

* The Hon. Mr. Justice Newton, who assiduously collected and took notes upon the Lepidoptera of Bombay, informed me that the *Charaxes Psaphon* of Westwood was continually persecuted by the bulbul, so that he rarely captured a specimen of this species which had not a piece snipped out of the hind wings ; he offered one to a bulbul which he had in a cage, and it was greedily devoured, whilst it was only by repeated persecution that he succeeded in inducing the bird to touch a *Danais*, which he offered to it.

instances in various parts of the world in which *Papilios* of certain groups are the objects of mimicry. Although Mr. Scudder has never seen a bird capture a butterfly, others have been more fortunate, and that they are thus captured very largely in the tropics is certain. It is not improbable, from the rarity of mimicry in the temperate zone, that the few cases which exist may have been produced under the more favourable climatal and organic conditions of the semi-tropical epochs anterior to the glacial period. ALFRED R. WALLACE

The Difficulties of Natural Selection

THE papers read by me before the Entomological Society "On the Relation between the Colour and the Edibility of Lepidoptera and their Larvæ" having been noticed and commented upon by Mr. A. W. Bennett and others in NATURE, I have deemed it desirable to offer a few remarks on the subject.

The object I had in making the experiments was to ascertain whether there could be proved to exist any relation between the colours of larvæ and their edibility.

The disciples of Mr. Darwin argued that the brilliant colours of so many male birds arose from sexual selection, and that the equally striking colours of flowers were but guides to insects, to enable them to distinguish, at some distance, the flowers from the leaves, and thus insure fertilisation by the interchange of pollen. Such reasons, however, were quite valueless to account for the bright colours of the asexual larvæ of many Lepidoptera, several species of which are banded and striped with blue, yellow, and red; colours which instead of concealing them by harmonising with the leaves on which they feed, are often in complete contrast with them.

Now Mr. Wallace had a theory that these gaily coloured larvæ were uneatable by birds, and that their gay colours were protective, because if they were indistinguishable from eatable species, they would be seized by birds, and though rejected afterwards, would be so much injured that the probability of their becoming imagines would be very remote, even if they were not at once killed.

This I found to be the case; in my experiments extending over many years, and most carefully made with several species of birds, I have not met with one instance in which a strikingly-coloured larva was eaten. In most cases they were not even regarded when thrown into the aviary, although I had several birds always on the watch for the eatable species, with which I constantly fed them; while these latter were seized immediately they were seen.

The larva of the *Cucullia verbasci* is conspicuously coloured blue and yellow, and feeds without any attempt at concealment on several species of Verbascum. I placed the plants in the aviary, and fed the Cucullidæ upon them until every leaf was devoured, and the caterpillars gnawed holes in the stem; but not one was in the slightest degree injured, yet at the same time other larvæ were greedily eaten.

On the other hand, I found that all larvæ were eagerly eaten which have soft smooth bodies and dull colours, while the hairy larvæ are rejected entirely.

These eatable species are protected in various ways; some are nocturnal in their habits, descending to the ground during the day; some feeding on the under sides of the leaves; others arrange their bodies in a line with the shoots of the plants and look like a streak of the bark; some are of precisely the colour of the leaves, or even of the corolla of the plant on which they feed; others roll themselves up in leaves, the larvæ of the *Geometridæ* are often exactly like twigs, with the terminal and side buds imitated.

This latter resemblance is so complete that, after being thirty years an entomologist, I was deceived myself, and took out my pruning scissors to cut from a plum-tree a spur which I thought I had overlooked. This turned out to be a larva of a Geometer two inches long. I showed it to several members of my family, and defined a space of four inches in which it was to be seen; but none of them could see that it was a caterpillar. Surely this was a case of protective mimicry.

All the eatable larvæ agree in not moving when there appears the least danger, and very rarely moving at all during the day.

Even if there were no cases of protective mimicry in the larval states of Lepidoptera, I do not think that would be any argument against the existence of such in the perfect state. It appears to me rather that as so few specimens become imagines in proportion to the eggs produced, the more need is there that these few should survive.

I cannot, therefore, agree with Dr. Scudder in thinking that mimicry has been supposed to exist where it is least wanted, viz., in the perfect state of Lepidoptera. Nor can I coincide with Mr. Bennett that it is a matter of indifference to the supporters of the theory of Natural Selection whether twig-like caterpillars are eaten by birds or not. My point is that they are often so like twigs that they are passed over as such by insectivorous birds, and that the closer the resemblance the better their chance of escape.

I believe myself that Mr. Darwin's theory will survive, and even be benefited by, the criticisms of its opponents; but what I do dread is the injury it may receive from the false arguments of some of its illogical supporters.

Lest I may unwittingly place myself in the latter category, I will bring my remarks to a close. J. JENNER WEIR

6, Haddo Villas, Blackheath, S.E.

Butterflies and Birds

A CORRESPONDENT in NATURE, Dec. 22, states that after fifteen years' experience in butterfly hunting, he has never seen one in a bird's bill. I was not aware the circumstance was unusual, for I have frequently seen the common sparrow chase and capture such butterflies as *V. urticæ* and *P. rapæ*. It is quite a hare and greyhound affair, the butterfly often eluding for some time the swift pounces of its pursuer, so that the hunt is a long one. T. G. B.

St. John's College, Cambridge

Ceratodus Forsteri

SIR PHILIP GREY EGERTON presents his compliments to the Editor, and would esteem it a favour if he would insert the following paragraphs, from two letters recently received from Professor Agassiz, in an early number of NATURE. It will be gratifying to all men of science to know that the distinguished Professor has so far recovered from his late severe illness as to be able again to interest himself in scientific pursuits.

Oulton Park, Tarporley

"Cambridge, November 9

"I am slowly recovering, and find myself gradually returning to the ways of active life. As I wake anew to feel an interest in scientific pursuits, there is nothing for which I have a greater longing than the fossil fishes. If I could leave my house I would fly to you to resume the examination of your and Lord Enniskillen's collections. The recent discovery of Krefft has added fuel to the fire, and I feel the most intense desire to revise the facts bearing upon the relations of the Ganoids and Selachians in general, and more particularly those of the Cœlocanthi, to which, from the examination of the skeleton sent me by Krefft, I find his *Ceratodus Forsteri* belongs. It will no doubt turn out that the Dipterini are close relations. In this connection I am reminded of what you once wrote to me of the teeth of Ctenodus. Will you now have the kindness to give me all the particulars? I am having sections of the teeth of *Ceratodus Forsteri* and some of the fossil species made for comparison. I have little doubt already that this genus will turn out to be one of the most curious *synthetic* types (I call them) in the animal kingdom, exhibiting characters of Placoids (Selachians) in the teeth, Ganoids in the scales, their embryonic characters in the preservation of a dorsal chord, instead of distinct bony vertebræ, and finally hollow bones as in birds."

"Cambridge, Dec. 8

"I take it some of your naturalists will crow over what they will be pleased to call my stupendous mistake in referring the teeth of Ceratodus to the Selachians, when the fish proves to have large imbricated scales; and yet I never was more pleased than when I learned the fact, for it settles beyond dispute the existence in nature of types, to which I have long ago called attention, under the name of *synthetic types* (see my Essay on Classification), but of which naturalists have thus far taken little or no notice. When I described the teeth of Ceratodus as those of a distinct genus among the Cestracionts, I was led to do so by appearances which secured for this association the assent of all naturalists. As long as the fossil teeth only were known, nobody questioned the relationship. Owen himself, in his 'Odontography,' mentions the teeth of Ceratodus and their structure, and has not a shadow of a doubt that I am right in placing that genus near Cestracion; and now comes the discovery that Ctenodus, a genus also referred to the Cestracionts, is based upon the dental plate of a bony fish, closely allied to the one recently discovered by Krefft, and referred by him to

the genus Ceratodus. Is not all this the most palpable evidence that there exist in nature types which combine structural features that are entirely separate in other types? and it is to such types I have applied the name of synthetic types."

Lumiere Cendree

IT may perhaps be of some interest to you to know that the phenomena of "Lumière cendrée" was distinctly seen in Surrey on the evening of the 25th inst., between 4 and 5 P.M. With the aid of an opera-glass, I saw clearly the whole of the dark portion of the moon's disc; and some friends who were with me at the time were able to see it with the naked eye.

H. G. S. SMITH

Trinity College, Cambridge, Dec. 27

Measurement of Mass

WITH reference to the very favourable notice in your last number of my edition of Deschanel's "Traité de Physique," will you allow me to remark that my reason for rewriting the section on *mass* (§ 42) was that Deschanel, in accordance with what has been till recent years an almost universal custom, employs a variable unit of force, and, as depending upon this, a variable unit of mass, so that the number denoting the mass of one and the same body is diminished as the body is carried from the equator to the poles, and would increase up to infinity if the body fell to the centre of the earth.

The reviewer says, "the conception of *mass* is always a difficult one for a beginner." This is doubtless true when the conception is hampered with the inconsistencies arising from this vicious system of measurement; but I do not think the conception of a *pound* or *gramme* of matter presents much difficulty, and these are the units in which, according to the best modern usage, I have indicated that mass is to be expressed.

As regards the coefficient of absorption of ammonia, the reviewer is right. A mistake was committed in extracting the number from a table, of which, if I may judge by his initials, the reviewer is the author. In future, I would entreat him to make his tables more easy of reference. J. D. EVERETT

Belfast, December 26

Hailstones

IN NATURE of the 15th there is an account of hailstones of a form deviating considerably from the spherical. Hailstones are frozen raindrops, and a rain-drop falling through a vacuum would of necessity be spherical, but in falling through the air it must tend to assume the form of least resistance, whatever that may be. I was told many years ago of hailstones which had been picked up and found to be of the form of Minié bullets. I do not vouch for the truth of this, but I think it likely; the Minié bullet was, I believe, the nearest approach to the form of least resistance that the inventor was able to arrive at.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, Dec. 20

Darlingtonia Californica

MR. ROBINSON'S suggestion, reported at page 159, as to the cultivation of this plant in England, has been anticipated by Messrs. Veitch and Sons, who have grown the plant for a considerable time in their houses at Chelsea.

In London, as in California, this curious plant possesses the same irresistible attraction to insects, and as I have repeatedly examined living plants at Chelsea, perhaps the following notes taken in connection with those printed in your last number may have some interest.

This so-called "pitcher plant," when fully grown, resembles in shape the upraised head and body of an excited cobra, with hood expanded and prepared for a spring; the head is at right angles with the hollow vertical body, and apparently presents no opening by which an insect could enter; under the place where the lower jaw would be, hang two large reddish appendages like the "wattles" of a fowl. At Chelsea this plant possesses such an extraordinary attraction for flies (principally blue-bottles), that the hollow "pitchers" are generally full of their dead bodies; what this attraction is I am unable to say, as the plant is scentless.

Last year I had a Darlingtonia before me for some three or four hours, whilst sketching it, and I then observed that the blow-flies made straight for it immediately they entered the room. Insects alight on the red "wattles" and then fly upwards into the (previously unseen) red-lipped entrance to the tube; owing to the sudden twist in the neck of the pitcher, they are at once compelled to descend the hollow body, and, as far as I have observed, they never return alive. They keep up a buzzing noise for half an hour or so, and then apparently die.

The old "pitchers" are generally full of dead flies, &c., and the lowermost insects, in rotting, cause the "pitchers" to decay and split, the flies within being then displayed. These dead flies often drop out through the fissures and become grouped round the bottom of the plant.

WORTHINGTON G. SMITH

Aurora Arcs in the East

I AM inclined to agree with Dr. Burder as to the invisibility of Auroras by daylight, yet I can confidently assure him that I have many times seen the arch "almost due east," that is when the extremities point N.N.W. and S.S.E. When such a phenomenon occurred in Newfoundland, some of the old weather-wise settlers would tell me to expect falling weather (snow or rain) on the following day, as the Northern Lights were in the south. But I am sorry to say that I did not note how often the Aurora appeared as above, but I *did* note that snow fell on *seventy-eight* consecutive days in the autumn of 1867 and commencement of the winter of 1868. HENRY REEKS

The Milky Way

IN the number of NATURE for November 17, Mr. John Jeremiah states that "Heol y Gwynt" is the only proper Welsh name for the Milky Way. Such is far from being the case. I am acquainted with no less than *nine* other names, equally proper for that luminous appearance, such as *y llwybr llaethog*, *y ffordd laeth*, *llwybr y gwynt*, *galaeth*, *eirianrod*, *crygeidwen*, *caer Gwydion*, *llwybr Olwen*, and *llwybr y mab afradlawn*. Of these names, *y llwybr llaethog* and *y ffordd laeth* answer precisely to Milky Way; *llwybr y gwynt* (common enough in Carmarthenshire) is synonymous with *heol y gwynt*; *galaeth* (from *llaeth*, milk) corresponds with galaxy; *eirianrod* signifies a bright circle; and *crygeidwen* a white cluster. To *caer Gwydion* (the mural enclosure of Gwydion) belongs a tale, which may be compared with the stories of classical antiquity on the same subject. Gwydion is a noted character in early Welsh romance, in which he figures as an astronomer and an enchanter. He was the son of Don, king of Llychlyn or Scandinavia, and is said to have lived in the fourth century. According to the Welsh poets, he travelled through the heavens in search of a lady, who had eloped with Gronwy Befr, and left a track behind him, which has ever since been called *Caer Gwydion*. When he found the faithless lady he changed her into an owl. His scientific acquirements are often mentioned in Welsh mythology, and frequent allusions are made to him as an enchanter by the early bards. He is said to have been instructed in magical arts by Math ab Mathonwy, and in the Mabinogi, or tale which bears the name of the latter, his achievements are detailed at length. According to some of the Welsh records he was buried at Morfa Dinlle, on the seashore near Carnarvon.

Gwydion is not the only one of the family of Don whose name is associated with astronomy. Don himself gave his name to the constellation of Cassiopeia, which is called in Welsh *Llys Don*, the Court of Don; and *Caer Arianrod*, the Corona Borealis or Northern Crown, is so called after his daughter Arianrod.

Llwybr Olwen (the path or course of Olwen) refers to another distinguished character in Welsh mythology. Olwen was the daughter of Ysbyddaden Bencawr, a prince of the Northern Britons, who lived in the sixth century. Her extreme beauty was proverbial, and her charms are frequently alluded to by the ancient bards. It is stated of her that four white trefoils sprang up wherever she trod, and from this circumstance she was called *Olwen*, or white track. She was sought in marriage by Cilhwch, prince of Clyddon, and his adventures in order to obtain her form the subject of the Mabinogi of Cilhwch and Olwen, which will be found printed, with an English translation, in Lady Charlotte Guest's "Mabinogion," ii. 197, 249

What connection the other name, *llwybr y mab afradlawn* (the path or course of the prodigal son), may have with the

Milky Way, is not obvious, as I am not aware of the existence of any fable bearing on the point.

D. SILVAN EVANS

IN reply to Mr. Reeks, I was quite correct in stating that the wind would blow in the course of the Milky Way; and to be sure of it, I have communicated with my friend at Llangadock, who has repeated what I have previously stated. He also tells me that on Sunday night (the 11th inst.) he looked out and found the "wind blowing from the east, and the Milky Way was to be seen coming from the north-east." He still thinks it possible to predict the weather by this kind of observation. However, apart from this, the Welsh word is sufficient to prove the correctness of my former letter, which means the "Road of the Wind."

Dec. 13 JOHN JEREMIAH

Meteoric Shower

I OBSERVED a most beautiful star-shower on the night of the 5th inst., at about a quarter to nine o'clock. It crossed the "tail" of Ursa Major in a direction almost easterly, and slanting towards the earth at about an angle of 30°. At first the phenomenon resembled the flight of a flock of wild geese, but after a little the nearer stars inclined towards the earth more than those farthest away, so that in all I could see about thirty stars. I write to you as the period of recorded star-showers mentioned in Prof. Ansted's Physical Geography, is from Dec. 6th to 13th, and I observed this star-shower on the 5th December.

The Commons, Killybegs, Dec. 14 JOHN C. WARD

Hereditary Deformities

THE articles upon this subject in NATURE, Sept. 8, Oct. 20, and Nov. 3, remind me of what I learned fifteen years ago while visiting tribes of Sioux Indians, assembled to the number of 5,000, near the mouth of the Yellow Medicine River, in Minnesota. The Indians were collected at this point for the purpose of receiving their annuities from the U.S. Government, and were accompanied by their families. It is customary for the squaws of their tribes to have tattooed upon the prominences of their cheek-bones small discs, of from one-eighth to one-fourth of an inch in diameter. I was informed by a physician, who has passed much of his time with these tribes, that sometimes a child was born with these marks. This was confirmed by the U S. Government Indian Agent. I had no means of verifying these statements; they were believed by my informants, who were gentlemen of veracity.

CHAS. M. WETHERILL

Lehigh University, Nov. 19

Right-handedness

CANON KINGSLEY is a close observer of nature, and if his generalisation be correct in the following instance, it would seem that the tendency to develop the right arm to the comparative neglect of the left is not confined to man. In describing the call-crabs of Montserrat, he says that one of the claw-arms, generally the left, is dwindled to a mere nothing, and is not seen, while the other is disproportionately large. I am well aware that the claws of lobsters are seldom equal in size, but have had no opportunity of ascertaining whether it is the right or the left claw which is superior, nor whether there is any rule in the matter. C. J. R.

Sun Stroke

IN the *Revue des deux Mondes* for the 15th August (page 854), there is a remark which, though somewhat exaggerated, is of very great value and practical significance. The writer says, "The phenomenon known as 'Sunstroke' is due to the action of light, and not, as is generally believed, to the elevation of temperature." An exception has to be made in cases where the sun playing, especially on the back of the head and neck, produces unmistakeable sunstroke. Every surgeon practising in the East also meets instances of "solar apoplexy," which present themselves as often as not during the night, but only in the excessively hot weather. However, I know from personal experience that it is quite possible to lay oneself up completely with intense headache, constant nausea, cold extremities, &c., by exposing the eyes only to the glare of the sun, the head and neck being completely sheltered by a helmet and *puggree*, and the body being at rest in a carriage. Further, I have found it possible, when accidentally obliged to expose myself, to avoid all inconvenience by merely wearing deeply-smoked glasses, my head being guarded only by an ordinary felt hat. But this is an experiment not to be tried rashly. The conclusion obviously is that whenever there is an intense glare, whether attended by intense heat or not, the first condition to fulfil is to shelter the eyes. As the retina is in truth an expansion of the brain, the brain is more accessible to external influences through the eyes than through any other avenue. R. A. JAMIESON

Shanghai, Oct. 24

GLYCERINE EXTRACTS OF PEPSIN AND OTHER FERMENTS

A SHORT time ago Von Wittich published in *Pflüger's Archiv* some interesting results of an attempt to isolate, by means of concentrated glycerine, pepsin and other so-called ferments found in animal and vegetable bodies.

The mucous membrane of a pig's stomach, washed and freed as much as possible from water, was finely minced and bruised, and then covered with pure glycerine. After standing twenty-four hours, a few drops of the glycerine, diluted with acidulated water, digested fibrin with remarkable rapidity. After pouring off the whole of the glycerine, a second, third, and even fourth glycerine extract could be made, all manifesting strong peptic powers. On treating, after filtration, these glycerine extracts with a large excess of alcohol, a slight precipitate was obtained, which, separated by filtration and re-dissolved in acidulated water, though giving only the faintest proteid reaction, was strongly peptic.

In a similar manner salivary gland and pancreas gave up to glycerine an amylolytic or starch-converting ferment, almost entirely free from proteids, and a "laden" pancreas also gave up a ferment capable of digesting fibrin in an alkaline medium. Barley (*not germinated*) gave up to glycerine a non-proteid diastase; and almonds a ferment capable of acting on amygdalin.

I have repeated many of Von Wittich's experiments with almost entirely similar results. We certainly have in glycerine a new means of working out the intricate problems of these so-called ferments. The glycerine extracts, for the most part at least, seem to remain unchanged for a very long period, so that a stock of ferment can always be kept in store. On the other hand, tissues may, by repeated extraction with glycerine, be exhausted of their ferment, and yet little, if any, otherwise changed, so that they can be examined under conditions hitherto impossible.

Not the least value of the new method lies on the practical side. The means hitherto adopted of preparing the so-called pepsin for medical purposes are confessedly clumsy and inefficient. By glycerine we can now extract, without any trouble whatever, a pure palateable peptic liquid, one which apparently will last any length of time. It is, moreover, to be depended on for its peptic powers; any one who has fairly tested by actual experiment the various "pepsines" of commerce, will understand the value of this remark. M. FOSTER

NITRO-GLYCERINE AND GUN-COTTON

IT may be of some interest at the present moment to give a brief summary of certain comparative experiments undertaken with nitro-glycerine and gun-cotton, with a view to ascertain their respective destructive nature and safety of employment as industrial or warlike agents. As it is occasionally inconvenient to employ a material of this kind in the form of a liquid, a modification of nitro-

glycerine, known as dynamite, and which is simply powdered glass or sand saturated with the explosive, was applied in the experiments; the force of the dynamite very nearly equals that of nitro-glycerine, and is of course much more readily handled than the liquid explosive itself. Nitro-glycerine or its compounds are the only agents of this nature that can compete in any way with gun-cotton, either as regards its igniting force or cost of production; and for this reason the experiments with these two materials have been watched with particular interest by military men, and have indeed formed the subject of a special report recently submitted to Government by the Committee on Explosives.

The explosive force of detonated dynamite and the Abel gun-cotton, as the compressed or pulped form of this material is termed, was considered to be about equal, and on this account the investigation was more particularly confined to the methods of ignition of the two substances. Professor Abel had already shown, in his communication to the Royal Society, that gun-cotton detonated only under certain conditions and but by the instrumentality of particular agents. And here it should be borne in mind that there exists a very great difference between the detonation and inflammation of gun-cotton. A block of the compressed material, for instance, may be set fire to in an ordinary room without the semblance of danger, the cotton burning vigorously and rapidly, it is true, but without any approach to explosion; ignited, however, by means of a small quantity of fulminate of mercury or fulminate of silver, the explosion is of the most violent description. The fulminates above-named are the only ones found to bring about the ignition of gun-cotton in this truly terrible manner; iodide of nitrogen fails to have any effect thereon, and chloride of nitrogen is occasionally successful in doing so, provided it is employed as a primer in sufficient quantity. While, however, gun-cotton is thus very difficult of detonation, except by the use of special means, nitro-glycerine, or dynamite, readily detonates under ordinary circumstances. That is to say, not only do the fulminates above-mentioned secure its ignition, but percussion-cap and other compositions, as also a sharp concussion, inevitably bring about its combustion.

An interesting experiment will indeed show at once the marked difference between the two explosives. Two wooden boxes were filled with compressed gun-cotton and dynamite respectively, and placed in a suitable position at a rifle range, where they could be hit with certainty by small arms. A bullet was fired at each box, and the results were very conclusive; the dynamite detonated in a terrible manner at the shock, while the gun-cotton was merely inflamed, and burned in a rapid but steady manner.

It was further found that in order to secure certain and perfect detonation, it was always necessary to employ a much larger and more powerful detonating fuze (one containing a large amount of fulminate) for the explosion of gun-cotton than was required for nitro-glycerine, proving beyond doubt, therefore, that the latter is much more readily ignited than the fibrous material. This is of course a great safeguard, and added to the fact that under many circumstances of accidental ignition gun-cotton inflames harmlessly and does not detonate, speaks much in favour of pyroxiline. Indeed the use of nitro-glycerine can, according to our best authorities, be applied only within very narrow limits, as, for instance, for blasting and mining purposes, and its employment even in this sphere necessitates very careful supervision.

From this it will be at once seen that the recent prognostications of several of our war correspondents that the Prussians intend to employ dynamite shells in the bombardment of Paris must be entirely without foundation, for, according to the results obtained by the Explosive Committee in this country, the discharge of a nitro-glycerine shell from a gun would be of itself sufficient to bring about the immediate bursting of the arm itself.

ASSOCIATION FOR THE REFORM OF GEOMETRICAL TEACHING.

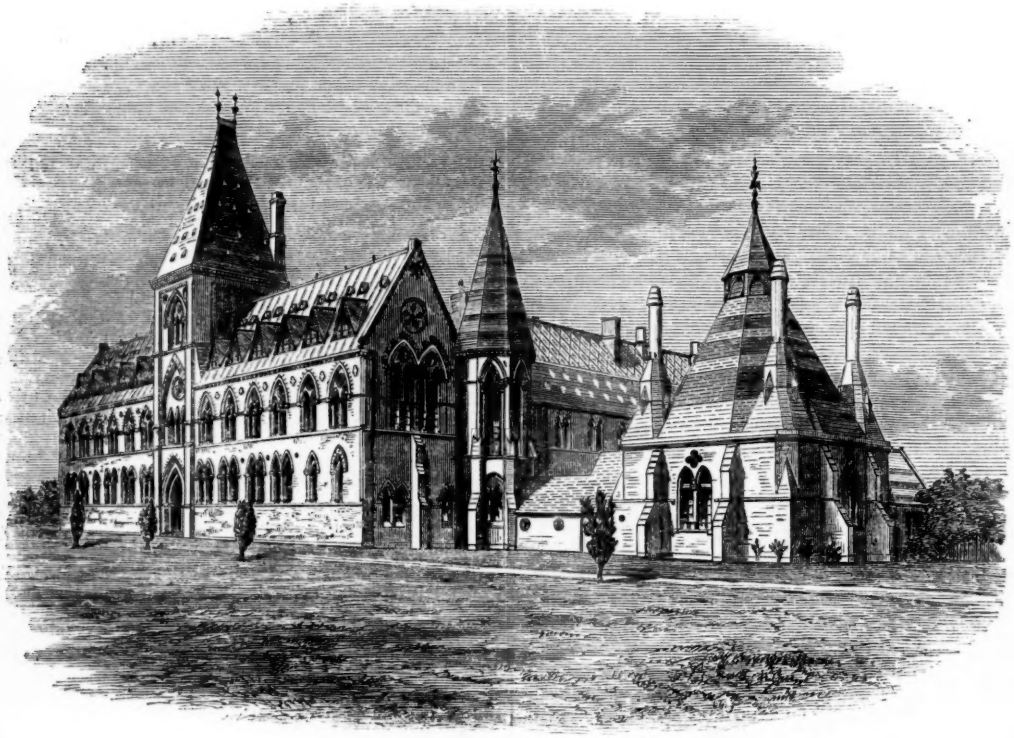
THE following circular has just been issued:—"For some time past an effort has been made to improve the teaching of Geometry in English schools. The undersigned—all mathematical teachers—are of opinion that good would result from the formation of an Association for the Reform of Geometrical Teaching, and are desirous to elicit the opinion of others who may be interested in the movement. The objects of such an Association would be—1. To collect and distribute information as to the prevailing methods of instruction in geometry practised in this and other countries, and to ascertain whether the desire for change is general. 2. To use its influence to induce examining bodies to frame their questions in geometry without reference to any particular text-book. 3. To stamp with its approval some text-book already published, or to bring out a new one under its own auspices. Should you be willing to become a member of such an Association, you are requested to send your name and address, with a small subscription to meet the necessary expenses of printing advertising, &c., to Mr. Levett, King Edward's School, Birmingham. (Signed) Rawdon Levett, M.A., Senior Mathematical Master, King Edward's School, Birmingham; E. F. M. MacCarthy, M.A., Second Master, presiding over the Modern Department, King Edward's School, Birmingham; J. M. Wilson, M.A., late Fellow of St. John's, Cambridge, Mathematical Master of Rugby School; Robert Tucker, M.A., late Scholar of St. John's College, Cambridge, Hon. Sec. London Mathematical Society, and Mathematical Master, University College School."

A Conference is intended to be held on the 17th of January, 1871, at 2 30 P.M., in the Mathematical Theatre, University College, London, Dr. Hirst in the chair, for the following purposes:—The Association will first be organised. The following resolutions will then be proposed: 1. "That the main object of this Association is to induce all conductors of examinations, at which pupils who have been trained under different systems present themselves, to frame their questions independently of any particular text-book; and that with a view to this object, the members present at this meeting do pledge themselves to use every effort to increase the numbers and extend the influence of the Association." 2. "That with a further view of extending the influence of the Association, local secretaries be appointed for different parts of the kingdom, whose office it shall be to collect information, to make the objects of the Association more generally known in their immediate neighbourhood, and to communicate on all matters of interest with the Central Committee." 3. "That the local secretaries, *ipso facto*, be members of the committee of management." 4. "That all members of the Association shall collect information with regard to text-books and methods of teaching geometry in England and other countries, and that such information shall be forwarded to any secretary or local secretary of the association." 5. "That the committee of management shall, from time to time, print and circulate among others such information as they may consider valuable." 6. "That this meeting is of opinion that in any new text-book—(*a*) the following principles, only partially or not at all recognised by Euclid, should be adopted:—(i) hypothetical constructions, (ii) the arithmetical definition of proportion, (iii) superposition, (iv) the conception of a moving point, and of a revolving line; (*b*) the following limitations should be removed:—(i) The restriction of the number of axioms to those only which admit of no proof, (ii) The restriction which excludes all angles not less than two right angles; (*c*) modern terms, such as locus, projection, &c., should be introduced. These points will be voted upon in detail.

NATURAL SCIENCE AT OXFORD

THE progress which Natural Science has made at Oxford within the last few years has far exceeded the anticipations of even the most sanguine of its promoters. It is but ten years ago that the New Museum was opened, and not much longer since the School of Natural Science was founded. Since then, year by year, the interest shown in these studies has steadily augmented, the number of undergraduates attending the University College Science Lectures has augmented in proportion as the number of these lectures has increased, and the School of Natural Science has become recognised as on a par with the other three great schools of Philosophy, Mathematics, and Law and Modern History. This has been chiefly brought about by the high standard of excellence required by the examiners in this school. When the position taken by Natural Science at a university which has commonly been condemned for neglecting this very subject, is fully recognised outside its own walls, there can be no doubt but that a far greater number than at present will come up to Oxford to pursue their science studies there. Hence it may not be here out of place to give as briefly as possible a short *résumé* of the opportunities held out to Natural Science students at Oxford, in the way of university and college lectures and the various scientific museums and libraries, as well as to notice the numerous rewards and honours which are open to all such students. To do this completely would far exceed the limits of this article, so that what follows must only be taken as a sort of index, as accurate as possible, to a subject, the details of which can be obtained by writing to the tutors of the various colleges mentioned.

Taking the rewards and honours first, we would notice



THE MUSEUM AT OXFORD

that the following colleges award scholarships and exhibitions for Natural Science, after an examination combining both book-work and practical work in any one or any two of the three great branches of Natural Science, Chemistry, Physics, and Physiology.

Balliol—one of 75*l.* every alternate year; one to be given in 1871.

Merton—one of 80*l.* and one or two exhibitions every year; no limit to age.

Christ Church—one of 100*l.* every year; age not to be above twenty.

Magdalen—one of 75*l.* and one or two exhibitions every year; age not above twenty.

Jesus—one of 80*l.*, generally every year; no limit as to age.

New College—one of 100*l.* occasionally.

Queen's—one of 75*l.* occasionally.

Lincoln—one of 60*l.*; a closed scholarship generally given to Owens College students.

There is but little doubt that many of the other colleges will give similar scholarships as time goes on.

But far greater rewards than these are the various fellowships, of from 150*l.* to 300*l.* per annum, which are open generally one or more every year, either for Natural Science alone or for Natural Science combined with Mathematics. These fellowships are awarded after a competitive examination, and are open to those who have taken their B.A. degree; and, unlike the system in vogue at Cambridge, they are open to all members of the University, and are not confined to the members of the particular college which offers the fellowship. Fellowships have been given for Natural Science at the following colleges: Merton,

Pembroke, Wadham, and Oriel, and, we believe, at Queen's and Magdalen, and one is to be given next February at Brasenose for Mathematics or Natural Science. It may not be superfluous to add that those who do not succeed in obtaining such a high reward as a fellowship, if they have taken a first class in the Natural Science School at Oxford, rarely fail to obtain valuable appointments after taking their degree, as Natural Science masters or lecturers at various colleges and public schools, whilst some are induced to stay up at Oxford as demonstrators and assistants to the professors, or else as college lecturers or private tutors.

In addition to the purely college rewards just mentioned, the University offers the following valuable emoluments, the first two only open to those who have taken their B.A. degree. The Radcliffe travelling fellowship, of the value of 200*l.* a year, and tenable for three years, of which eighteen months *must* be spent abroad, and the holder must be studying medicine and ultimately take his medical degree at Oxford. The Burdett Coutts Geological Scholarship of about 60*l.* for two years. A gold medal for the Johnson Memorial Prize Essay on some Natural Science or mathematical subject, awarded every four years. Various special prizes for essays, &c., given to the University by various benefactors.*

In addition to these, all the various open University Scholarships and prizes, so numerous at Oxford, are, of course, open to Natural Science students as to all others.

Every term, speaking generally, courses of lectures are given on the following subjects :—

Chemistry, by Prof. Sir B. C. Brodie, Bart., F.R.S.; Physiology and Zoology, by Prof. Rolleston, F.R.S.; Geology, by Prof. Phillips, F.R.S.; Physics (Heat, Light, and Electricity), by Prof. Clifton, F.R.S.; Botany, by Prof. Lawson, M.A.; Zoology (Invertebrate), by Prof. Westwood, F.R.S.; Mineralogy (occasionally), by Prof. Maskelyne, F.R.S. These lectures are open free to all undergraduates.

Lectures are also given at various Colleges, as at Christ Church, on Chemistry (advanced), by Mr. Vernon Harcourt, F.R.S.; on Physics and Mechanics, by Mr. Reinold; and on Physiology, by Mr. Thompson; at Merton on Chemistry (theoretical); at Magdalen on Physiology and Chemistry; at Wadham on Physics and Mechanics, which are open free to the members of the respective Colleges, and on payment of a small fee to others.

In addition to these lectures, a large amount of practical work is made an absolute necessity for a degree in the Natural Science School. Every opportunity for this practical work is given at the Museum, where, under one roof, all the various splendid collections of comparative anatomy, geology, mineralogy, and instruments for experimental, physical, and chemical science are collected together, and are made available for instruction. It is here also that all the University lectures are given, with the exception of those on Botany, which are given in the Botanical Museum in the Botanic Gardens. The illustration on the opposite page is from a photograph of the Museum taken before the building of the New Physical Laboratory. It would occupy far too much space in the present article to describe the contents of this Museum, adequately. Suffice it to say that on the left-hand side are the rooms occupied by Professor Rolleston, for practical work at physiology and comparative anatomy and osteology, fitted up with every convenience, and freely communicating with the general collection of specimens on these subjects placed in the Central Court. On the opposite side are the rooms and collections of Professor Phillips in geology and mineralogy, and above these in the gallery the magnificent collection of insects and invertebrata under the superintendence of Prof. Westwood.

* Thus a prize of 50*l.* was awarded last year for an essay "On Longevity" by an anonymous donor through the University; and a prize of 100*l.* is now offered for an essay to refute the materialism of the present age.

The building on the right-hand side, built apart from the Museum, but connected with it by a narrow passage, is the chemical laboratory. On the opposite side of the central building, not shown in the illustration, is the fine building lately erected as a physical laboratory for Professor Clifton. This building, which is the most perfect physical laboratory in the world, was only opened this term. The collection of physical science apparatus is very valuable, most of it having come from the last Paris Exhibition.

There is every facility given at the Astronomical Observatory for a practical acquaintance with astronomical instruments and methods of observation. There is a good chemical laboratory at Christ Church, as well as one at Magdalen, where, also, the valuable collection of fossils and minerals of the late Dr. Daubeny is open to all working at these subjects. Magdalen, also, has a very good astronomical telescope, and various modern meteorological instruments. A collection of minerals and geological specimens is also in process of formation at Merton. The Botanic Gardens contain every requisite for the thorough study of botany, and in the Museum in connection with it, is a very large and valuable herbarium containing collections of plants for every quarter of the globe.

Lastly, we have to mention what will ultimately tend as much, if not more, than anything else, to make Oxford the great home of Natural Science in the future. We allude to the splendid Radcliffe Scientific Library in the Museum. This Library occupies one side of the building, and consists of two great rooms each 80 feet long, 24 feet wide, and 20 feet in height. It contains the finest collection of scientific books almost in the world, certainly the most accessible. The importance and value of this fine Library cannot be over-rated. Connected with the Bodleian and the Radcliffe Libraries, it contains, as far as possible, complete sets of all the Transactions and Publications of every recognised Scientific Society in the world, and all the new scientific works are added as soon as published. Admirably arranged, admirably managed, freed from all narrow restrictions as to admittance, and open daily from ten to four, and twice a week in the evening from seven to nine, every possible facility is given to those who are working at Natural Science. We do not hesitate to say that until such libraries are founded in other places, Oxford cannot help becoming the great centure of scientific culture in England.

J. P. EARWAKER

NOTES

UNFORTUNATELY the weather does not appear to have been very favourable for the observation of the Eclipse in Sicily. The following telegram has been received from Mr. Lockyer, dated Catania, December 22, 9.40 P.M. :—"Observations of eclipse greatly interfered with by unfavourable weather, but substantial results have been secured. A definite [contact?] of the corona was noticed at a height of about one-third of radius as presented for corona. The sphero-spectroscopic method for first contact was successfully employed. The American observations of last year upon the corona are confirmed." The Astronomer Royal has received the following telegram, which was despatched by Lord Lindsay immediately after the Eclipse. Lord Lindsay's place of observation was La Maria Louisa, which appears to be near Puerto, the mainland station opposite Cadiz :—"Photographs successful. Two good pictures of corona. Polariscope doubtful. Sketching good. Corona [gives] continuous spectrum, no lines. Broken sky." From telegrams received from other members of the expedition, it is hoped that the weather may have been more favourable at the more westerly stations. At Oran, however, we hear that dense clouds covered the sky for twenty minutes before the period of totality; and till after it was over. The previous day there had been a gale of wind.

DR. RUSSELL, Lecturer on Chemistry at St. Mary's Hospital, has been appointed to the Chair of Chemistry at St. Bartholomew's Hospital, lately occupied by Dr. Matthiessen; who also, up to the time of his appointment at St. Bartholomew's, filled the Chair at St. Mary's.

DR. HENRY E. ARMSTRONG has been appointed Professor of Chemistry at the London Institution, an office once held by Mr. W. R. Grove, Q.C., F.R.S., and subsequently by Mr. J. Alfred Wanklyn. Dr. Armstrong studied chemistry under Professors Hofmann, Frankland, and Kolbe, and has been associated with Dr. Frankland and the late Dr. Matthiessen in original researches. The *Pharmaceutical Journal* states that this appointment is connected with a project for establishing practical chemistry classes in the laboratory of the London Institution.

THE American scientific journals record the death, in his twenty-ninth year, of Edward W. Root, Professor of Chemistry in Hamilton College, a pupil of Schneider, Rose, and Bunsen; From his grasp of mind, power of organisation, and clearness of enunciation of scientific truths, he was one of the most promising of the rising generation of chemists in America.

THE days named for the reception of the different classes of objects at the Annual International Exhibition for 1871 are as follows:—Machinery, February 1, 2, 3, 4; scientific inventions, Feb. 6 and 7; educational works and appliances, Feb. 8 and 9; pottery and raw materials, Feb. 10 and 11; woollen and worsted fabrics and raw materials, Feb. 13 and 14; sculpture not applied to works of utility, Feb. 15 and 16; paintings applied to works of utility, Feb. 17; sculpture applied to works of utility, Feb. 18 and 20; engraving, lithography, photography, &c., Feb. 21; architectural designs, drawings, and models, Feb. 22; tapestries, carpets, embroideries, &c., Feb. 23; designs for all kinds of decorative manufactures, Feb. 24; copies of pictures, mosaics, enamels, &c., Feb. 25; paintings not applied to works of utility, Feb. 27 and 28.

THE Royal Horticultural Society's meetings and shows at South Kensington for 1871 are fixed to take place on the following days, namely, on Wednesdays, January 18, February 15, March 1 and 15, April 5 and 19, May 3 and 17, June 7 and 21, July 5 and 19, August 2 and 16, September 6 and 20, October 4, November 1, and December 6. The date of the great provincial show at Nottingham, originally fixed for June 13—17, has been altered, and it is now arranged that it shall commence on June 27, and continue till July 1. The principal meetings at South Kensington will be those on March 15, April 19, May 17, June 7, and July 5, the latter being the National Rose Show

THE days fixed for the Exhibitions of the Manchester Botanical and Horticultural Society, in the gardens at Old Trafford, next season, are, we understand, as follows:—The National Show, now become one of the most important events of the year, will commence on May 26, and continue till June 2; this will include the Royal National Tulip Society's Show on May 26, 27. In addition to this, a great Exhibition of American plants will be made by Mr. Anthony Waterer, of Knap Hill, the period extending from May 26 to June 17, and an Exhibition of Roses and Fruits will take place on July 7, 8.

THE Royal Botanic Society has just issued schedules for its two spring shows in 1871, which are each to be of two days' duration, and are fixed to take place on March 22, 23, and April 12, 13. As usual, new plants and plants of economic interest are admissible, though not scheduled. The Society's summer shows are announced for May 25, 26 (Thursday and Friday), June 14, 15, and July 12, 13 (Wednesday and Thursday).

A DISCUSSION having been carried on in the French Institute on "Winds," M. de Fonvielle sent to the Secretaries a quotation from the works of the celebrated philosopher, M. Mariotte, the author of the "Law for the Expansion of Gases," explaining the fall of pressure noticed during the south-western winds by the direction of the aërial stream which blows from the lower parts of the atmosphere to the higher. He says, moreover, that winds coming from northern quarters descend instead of ascend, and he accounts in this manner for the augmentation of pressure. This note was published in the *Comptes Rendus* at the time.

M. GAUTHIER-VILLARS, the scientific publisher, has completed the publication of Father Secchi's work on the Sun. It comprises more than four hundred octavo pages, and will certainly be largely circulated when Paris is open. Father Secchi has written it in French, having secured the assistance of some learned Jesuits. It is not, however, merely a translation of his former Italian work on the same subject.

A CORRESPONDENT of the *Gardener's Chronicle* has forwarded to that paper the following account of the condition of some of the nurseries near Paris, dated "Châtenay, Dec. 4, 1870.—I am sorry I have but sad news about the establishments; they are all deserted, and the magnificent collections are perishing. In detail I can only report of the establishments of MM. Croux and Durand Fils; the others near Bagneux, Châtillon, and Bourg-la-Reine we only passed several times at night, when marching to the batteries in course of erection, for the staying there during the daytime is not very agreeable on account of the shells from Vanvres, Montrouge, and Bicêtre. M. Croux's principal establishment at Châtenay is the quarters of the Staff of the Bavarian Artillery; the large Palm-house, sixty to eighty feet long, is occupied by the horses, the flower-tubs being made use of for cribs; the magnificent Conifers (Wellingtonias, Pinus Pinsapo, &c.), of which we found numbers of fine specimens, have all been cut down to form a fence along the road to Fontenay-aux-Roses, to prevent the French from having a look into our batteries from their forts. But the most sad sight is offered by the Jardin pour les études pomologiques, belonging to M. Croux, and situated near Aulnay. The beautifully trained fruit trees, after having been much broken by the pulling out of the wires, which were used for making gabions, are now completely eaten down by the 2,000 sheep and 80 to 100 cows shut up in the garden. Nor have the nurseries in the open field been spared; the stems of the young trees had to serve as stakes for gabions, while the branches were used for fagots. A similar sad sight is afforded at the branch establishment of M. Durand Fils, near Clamart; the greenhouses being, to a great extent, demolished by shot coming down here as thick as hail, and the plants they contain are dried up or frozen, for we had $-6°$ R. $= 18°$ F. the day before yesterday, and yesterday morning a considerable fall of snow. It will be about the same with the other establishments not visited by me, and it may be taken for granted that the losses of these people are beyond replacement, and will bring many of them to the grave."

SILLIMAN'S *American Journal of Science and Arts* will, after the close of the present year, become a monthly journal. It was founded by Prof. Silliman in 1818, and now numbers 100 volumes. From its commencement it has been the leading vehicle for the original papers of American scientists.

BRITISH botanists will be glad to learn from Messrs. Longman's lists that Mr. Watson's "Cybele Britannica" may now be obtained from them at the reduced price of 5*s.* per volume. The three parts of the invaluable "Compendium" of the same work are also issued by them in one volume at 10*s.* The author considers that this "must largely supersede the usefulness of the original work," of which he still invites any possessor "to apply to him for a free copy of the Compendium as a necessary supplement thereto." He has already sent a copy to all the possessors of the four volumes with whose addresses he is acquainted.

DR. BUCHANAN, the Professor of Physiology in the University of Glasgow, has just published the third part of his "Essays on the Forces that carry on the Circulation of the Blood." The present part is engaged with the consideration of the Pneumatic Forces. He is of opinion that the ordinary acts of respiration powerfully influence the current of blood in its passage through the whole vascular system. In proof of this he adduces the collapse of the large veins of the neck observed during inspiration, and the fulness during expiration, the former of which phenomena he attributes to the tendency to a vacuum existing in the chest, and the pressure of the external air which empties the great veins of their blood and forces it into the chest; whilst the latter he considers to be due to the fact that, after the termination of an inspiration, no more blood, or very little, enters the chest till the beginning of the next inspiration, and the consequence is that the blood propelled onward by the force of the heart accumulates in the veins near the chest to an extent proportionate to the length of the interval. Again, in order to show that the influence of the respiration extends to the arterial system, he refers finally to the united testimony of all physiologists, who are agreed that the pulse is less voluminous and feebler during inspiration, whilst it recovers its volume and strength during expiration and the period of repose; and, secondly, to the movements of the brain when exposed by removal of the part of the skull. Dr. Buchanan draws attention also to the oscillations of the hæmastatic column observed by Hales, which are clearly associated with the respiratory acts; to the phenomena of asphyxia, and those of the fœtal circulation; the difficulty respecting the latter he ingeniously turns in his favour, by maintaining that, inasmuch as no movements of respiration take place here, the absence of this help to the circulation is supplied by the free communication existing between the right and left sides of the heart, whereby both ventricles are able to exert their influence in maintaining the system in circulation.

THE valuable museum at Brighton is being utilised by the delivery of conversational lectures in the geological, entomological, antiquarian, economical, and sanitary departments. The object is to explain the specimens, and we learn from the *Brighton Examiner* that the plan has been well carried out and has proved very attractive.

GUSTAV ROSE, one of the veterans of German geology, celebrated the 50th anniversary of his doctorate on the 9th inst., when the learned societies of Berlin sent delegates to offer him their good wishes and congratulations.

THE *British Medical Journal* prints the following as an appropriate pendant to the condemnation of tobacco by Kerckringius, cited in our issue for December 8, by John Allen, M.D., F.R.S., on the Evils of Alcohol (*Synopsis Universæ Medicinæ Practicæ*, Amstelodami, MDCCXXX, cap. xvi.) "There remains another sort of poisons, such as vinous spirits and intoxicating distilled liquors. The frequent and excessive tippling of these, as is the practice of each returning day, hath destroyed myriads of mortals, nay, hundreds of thousands more than all the poisons put together; whence I am wont to style this most pernicious evil emphatically THE HARM. It proves not only the parent of very many, and those the worst of diseases, but to numbers suddenly fatal; upon which accounts, if it deserve not the appellation of poison, I must confess I know not what does. Spirit of wine, taken inwardly, is death to almost all creatures; to vegetables of all denominations without exception, when applied by way of pabulum, even to the parent vine, whence itself is derived. The generous physician hath an unpleasant task upon his hands. Men addicted to these spirituous liquors abominably sacrifice day, night, and themselves, to continually sipping, as it were, a liquid fire. When all digestion is lost, the solids unbraced, the juices corrupted; when the human fabric, which hath been long tottering, is just falling to the ground—then are we called in to its support. What must we do? Even as town-scavengers (*scabini*); and ten to one but, after all the abandoned sot returns at once, like a sow that is washed, to wallowing in the mire. Thus he irrevocably prostitutes his health to the last, being prodigal of that life of which he ought to be most tender; and his early end is the consequence of intemperance. What advantageth then the doctor, and what the divine? Fruitless would be the endeavours even of a Luke himself in both his capacities, either as physician or as evangelist. Deaf as a rock to all counsel or persuasion, he runs into the very arms of death, and courts destruction. To this he is prompted by an eternal thirst, which he greedily indulges; and the greater the indulgence, the greater the thirst—the thirst of those pernicious distilled liquors, with which the tragic scene is expeditiously closed; and the dismal catastrophe, in the last moments, is the finishing both his bottle and himself."

A CORRESPONDENT in Honolulu, after making a botanical tour in the Kaala range, says, "Botanising on this island is not without considerable danger. Only imagine descending a steep decline of 70°, which had to be done chiefly by swinging from the roots of one tree to the branches of the next one below, and that at a height of 2,000 feet above the deep gorge beneath our feet." Nature, however, seems in all cases to provide a reward for her admirers, who voluntarily expose themselves to such dangers for the purpose of bringing to the eye of science her numerous hidden beauties, for the writer continues to say, he was not a little surprised by the discovery of a violet with splendid snow-white waxy flowers, some of which were almost half an inch in diameter and exquisitely perfumed. He considers it probably a variety of *Viola chamissoniana*, which he found in its ordinary state lower down in the forest; but the pure white flowers stretching out their long peduncles above the surrounding low undergrowth, and luxuriating in the full sunshine of an azure blue sky, far exceed in beauty those of *V. chamissoniana*, which are of the ordinary violet colour.

FROM the notes of a short tour through the eastern parts of the provinces of Echigo, Iwashiro, and Uzen, made in June and July of the present year by one of H.M. Consuls in Japan, we extract the following:—"In passing through Yazawa and some other villages, we found hemp, said to be of good quality, grown in frequent localities on the way, and vegetable wax trees in abundance. I was informed at Tsugawa that the extraction of lacquer from the same tree is prohibited there, the tree being reserved for the production of wax. As the lacquer is obtained by making incisions in the bark of the tree while young, the result of which is the death of the tree before coming to full maturity, both products can hardly be obtained from the same tree. This appears to be the reason for the prohibition. At Yonezawa, on the other hand, the extraction of lacquer from the tree is permitted, the result of which is, that little vegetable wax is produced there. I observed that many of the trees in the neighbourhood of Tsugawa had been injured, apparently, by the severity of last winter." The trees here alluded to are those belonging to the genus *Rhus*. The most important wax-producing species in Japan being *R. succedanea* L., the bulk of the varnish being yielded by *R. vernicifera* Dec. The wax is obtained from the small fruits, while the varnish is procured by tapping the trees. The species met with at Tsugawa must have been *R. succedanea*, as this species yields both wax and varnish. Several other species also yield varnish more or less in China and Japan. Little is known about the preparations of this varnish as used in the ancient lacquer work of the Japanese; and it is said that the modern workers in this article in Japan have themselves lost the secret of its preparation.

EARLY MENTION OF THE AURORA BOREALIS

THE explanation given by Mr. G. Henry Kinahan* of the superstition prevalent in Ireland regarding "showers of blood" is extremely interesting, and to a great extent the true one; but any student of Irish history must feel how difficult it is to apply it to the interpretation of not a few prodigies recorded in the earliest chronicles. The word "blood" is frequently met with in accounts of wars, in such a manner as to make it quite impossible to construe it into an allusion to the Aurora; nor is it in many places capable of a dual meaning, for instance, the "Chronicum Scotorum"† under A.D. 531, says, in relating the drowning and burning of Muircertach Mac Erca,—

> The king. Mac Erca, returns
> To the side of the Ui Néill;
> *Blood reaches girdles* in the plain;
> Territories increase afar.

Mac Erca was killed by a fairy woman named Sin. The words "Blood reaches girdles" are not very clear, but the Aurora cannot be meant. Under an earlier date it is related (A.D. 497)—

> The battle of Seghais—
> A certain woman caused it;
> *Red blood* was brought over lances
> By Duisech, daughter of Duach.

The further we go back, the obscurer it becomes, and the greater the difficulty in attaching a consistent meaning, especially such an one as a record of auroral appearances. In Dr. Lynch's "Cambrensis Eversus," vol. i., it says:—

"A.C. 673.—Fionachta succeeded his father in the throne. During his reign an enormous quantity of wine fell like fleeces of snow from the sky."

"A.C. 561.—Elim Ollfinachta . . . . succeeded . . . . He was called Ollfinacha, because snow, which fell during his reign, tasted like wine."

The first of these quotations might be explained by saying that an Aurora was visible during the falling of snow, which appeared red from reflection, but this will not do for the second. Under A.D. 604 (Chron. Scot.) occurs—

> Great was the *red sorrow*
> Over the chieftains of Erinn all—
> Aedh Slaine, with multitudes,
> Aedh Roin, Aedh Buidhe, were slain.

Here *red* sorrow means a "bloody sorrow," but I cannot see in this any reference to an Aurora.

For a more direct and satisfactory record of an auroral appearance, the following are given in Chron. Scot.:—

"A.D. 659; A.D. 660—Darkness on the Kalends of May, at the ninth hour; and in the same summer the sky was seen to burn."

"A.D. 670.—. . . . A thin and tremulous cloud, in the form of a rainbow, appeared at the fourth watch of the night of the fifth day before Easter Sunday, stretching from east to west in a clear sky. The moon was turned into blood."

"A.D. 680.—. . . . Loch nEchach was turned into blood." Perhaps this was caused by reflecting the colour of an Aurora.

The "Anglo-Saxon Chronicle" contains the next later observation:—

"A.D. 685.—This year it rained blood in Britain, and milk and butter were turned into blood.‡ The Chron. Scot. follows with:

"A.D. 688.—The moon was turned into the colour of blood on the festival of Saint Martin (11th November)." This is singularly corroborated by the "Brut y Tywysogion" (The Chronicles of the Princes.)§

"A.D. 688.— . . . . . it rained blood in the island of Britain, and in Ireland."

"A.D. 689.— . . . . a battle against the son of Penda. Bloody rain fell in Lagenia." (Chron. Scot.)

"A.D. 690.— . . . . the milk and butter turned to blood." (Brut y Tywy.)

"A.D. 692.— . . . . the moon turned of a bloody colour. (Brut y Tywy.)

We now come to a most perplexing record of phenomena, which cannot, I am afraid, be explained; they occurred in

"A.D. 714.— . . . . it rained a shower of honey upon Othan Bec; a shower of silver upon Othan Mór; and a shower of blood on the Foss of Laighen." (Chron. Scot.)

If the shower of blood means an Aurora, what do the other showers mean? What is a shower of honey?

The auroral hypothesis will not satisfactorily apply to the following:—

"A.D. 734.— . . . . This year the moon was as if it had been sprinkled with blood." (Anglo-Sax. Chron.)

But it may to the following:—

"A.D. 744.—This year a *red* crucifix appeared in the heavens after sunset." (Flor. Wor. and in Anglo-Sax. Chron., under A.D. 743.)

An Aurora is undoubtedly meant in the next record:—

"A.D. 793.— . . . . This year dire forewarnings came over the land of the North-humbrians, and miserably terrified the people; these were excessive whirlwinds and lightnings, and *fiery dragons* were seen flying in the air."* (Anglo-Sax. Chron.)

This may be taken as the *earliest direct mention* of an Aurora Borealis in England. "Fiery dragons" are not more inapplicable to the phenomenon than the term "merry dancers," till very lately used in the Orkneys.

The next mention of "blood," whether as a celestial phenomenon or not, I shall leave for others to say is:—

"A.D. 811.—This year was a year of prodigies. . . . . It was in it, also, cakes were converted into blood, and blood used to flow from them when being cut. . . . ." (Chron. Scot.)

Digressing for a moment, I am here reminded of what an Irishwoman told me. She said that in Ireland a man, for masticating the sacramental wafer, had a flow of blood from his mouth until he was well-nigh drowned. This blood-tradition seems not to have entirely lost its hold on the Irish peasantry, although appearing in so many garbs.

A *column of light* is recorded to have appeared, but very few will accept it as an Aurora Borealis:—

"A.D. 819.—. . . . heaven afterwards revealed the deed by means of a column of light." (Florence of Worcester.)

"A.D. 850.—. . . . a column of light shot up to heaven, and remained visible to the inhabitants of that place [Repton] for thirty days." (Flor. Wor.)

The next in chronological order is:—

"A.D. 866.—Loch Lebhinn was changed into blood, so that it became clots of gore, like the lights of animals, all round its edge." (Chron. Scot.) I may here remark how difficult it is to say what this record really means, especially when it states that the Loch became "clots of gore."

"A.D. 878.—It rained a shower of blood, which was found in lumps of gore, and blood on the plains of Ciannachta. . . ." (Chron. Scot.)

Perhaps the following may refer to an auroral appearance:—

"A.D. 890.—The heavens appeared to be on fire at night on the Kalends of January." (Chron. Scot.) But not so the next:—

"A.D. 898.—Aideidh . . . [was slain] in treachery . . . . a shower of blood was shed in Ard-Ciannachta." (Chron. Scot.) This looks very much like a repetition of A.D. 878.

The next observation does not occur till

"A.D. 938.—The sun was of the colour of blood, from the beginning of one day to the middle of the day following." (Chron. Scot.) I shall not attempt to say what this was caused by, as I cannot conceive the *sun* being visible during the *night*. The Chronicles I have had access to do not mention the word "blood," nor any miracle connected with natural phenomena since this date, that would afford the least ground for surmising that an Aurora Borealis was meant, till

A.D. 944.—When it records:—"Two fiery columns were seen a week before Allhallowtide, which illuminated the whole world." (Chron. Scot.) Knowing under what various forms Auroras appear, it may not be at all extravagant to suppose this "fiery column" to have been such a phenomenon; however, this is not so convincing as the next on record:—

"A.D. 979.—That same year was seen a *bloody* cloud, oftentimes in the likeness of fire; and it was mostly apparent at midnight, and so in various *beams was coloured*. When it began to dawn, then it glided away." (Ang.-Sax. Chron.)

* See NATURE, December 8, 1870.

† Published under the direction of the Master of the Rolls. Translated by W. M. Hennessy, M.R.I.A., 1866.

‡ Showers of Blood are mentioned as having taken place in Tit. Liv. Book 42, Sect. 20. It says: "There was a report of it's having rained blood for three days at a town in Italy." And in Pliny, Book 2, Chap. 56, "It rained blood when M. Acilius and C. Persius were Consuls."

§ Published under the direction of the Master of the Rolls. Translated by the Rev. John Williams Ab Ithel, M.A., 1860.

* In "The Philosophical Grammar" by Benj. Martin, 1738, there is given a list of fiery meteors, and among them are the various forms of the Aurora Borealis:—"*Ignis Pyramidalis*, the pyramidal fire, when it resembles a pillar of fire standing upright; *Draco Volans*, a flying dragon, when the middle parts be thicker and broader than the ends; *Capra Saltans*, a skipping goat, when it appears to have a skipping motion, to be sometimes kindled and sometimes not." (Pages 204, 205.)

Florence of Worcester mentions it as having been seen in

"A.D. 978.—At midnight [the 18th of the Kalends of May (14th April)], there was seen throughout all England a cloud, which was sometimes of a blood-colour, and sometimes fiery; it afterwards broke out into rays of different colours, and disappeared about daybreak." (Chron. Flor. Worc.)

Gaimar, in his "History of the English," repeats this in the following manner:—

"A.D. 978.—At night, as he [the murdered King Edward] lay in the moat, a heavenly light spread itself there; the light was bright (no wonder!) it very much resembled the sun. This ray came over the holy body—the top of it was in heaven."

Putting down 978 as the correct date, and which is confirmed by William of Malmesbury (so far as the death of King Edward is concerned), this year may be accepted as the one in which an Aurora was seen.

From the last date till the year 1052, I cannot find any mention of "blood"-phenomena, or direct references to auroral appearance, and again in this year the evidence is very vague; it says:—

A.D. 1052.—A tower of fire was seen at Ross-Deala, on the festival of St. George, during the space of five hours, blackbirds innumerable going into and out of it, and one large bird in the middle of it." (Chron. Scot.)

The next, still more puzzling, will be my last:—

"A.D. 1103.—In the province called Berkshire, in a place called Heamstede, *blood* was seen by many to flow out of the ground." (Chron. Flor. Worc.)

I think that it will now appear from this account that any attempt to lay down *one* meaning for the whole of the numerous mentions of blood-appearances must fail, although it is, in a few instances, very clear that an Aurora is meant; but it seems as if a distinctive interpretation must be applied to the entries above given. On the whole, it is quite certain that this phenomenon has been seen at very remote dates by the inhabitants of Britain and Ireland; also that the enigmatical "blood"-miracles were not confined solely to Ireland, but seem to have been revealed alike to the *Keltic* inhabitants of England and Wales. I say *Keltic*, because I find the majority of records among the Chronicles to relate more especially to the *Ancient Britons* and *Irish*, and in many cases I believe (as one may judge from the above chronology) the style of poetical descriptions and form of mythical allusions are Keltic. The well-known Druidical Hymns, which appear in old Irish literature, are fair specimens of what I mean. One in particular concludes a mythical story with, "and the third (brother), guided by the lightning from his brother's fingers, shoots an arrow at the swimming hag, who immediately disappears in a *pool of blood*."*

There are two vague poetical descriptions which I imagine to have been suggested by the Northern Lights, in Hesiod's "Theogony," where he describes the war between the Gods and the Giants in the West. (Elton's Translation.)

He says:—

> The gods from Saturn sprung, and those whom Jove
> From subterraneous gloom releas'd to light,
> Terrible, strong, of force enormous, burst
> A hundred arms from all their shoulders huge.
> (Lines 884—887.)
> . . . . . Through the void
> Of Erebus, the preternatural glare
> Spread, mingling fire with darkness.
> (Lines 924—926.)

From astronomical calculations this war is stated to have taken place at the autumnal equinox in the year 756 B.C., and to have terminated at the era of Nabonassar; so that such an appearance *may possibly* have assisted Hesiod in composing this poem. The Hindu astronomers also seem to have heard of, or seen a heavenly phenomenon, which I imagine to have been something like an Aurora, if the hypothesis be true, that with the ancients natural phenomena were invariably made the themes of their verse, and were shrouded in allegorical descriptions. The most remarkable passage I have met with occurs in the Mahābhārata, Book i. chap. 15 (Wilkins's Translation):—

"They now pull forth the serpent's head repeatedly, and as often let it go; whilst there issued from his mouth, thus violently drawing to and fro by the Suras and Asuras, *a continual stream of fire*, and smoke, and wind, which, ascending in thick clouds replete with lightning, *it began to rain down upon the heavenly bands*, who were already fatigued with their labour."

* See Thierry, "Hist. de Gaull.," and Pritchard's "Eastern Origin of Celtic Nations."

The date of this supposed war is placed at 945 B.C.

If the foregoing passages be compared with what the "Prose Edda"* says, the hypothesis will not appear unreasonable. In the chapter on "The Twilight of the Gods, and the Conflagration of the Universe," it says:—

> Midgard's protecting warl
> Bravely fights and slays
> The serpent monster.
> Then shall all mankind
> The earth abandon.
>
> Dimm'd 's now the sun,
> In ocean earth sinks;
> From the skies are cast
> The sparkling stars;
> The fire-reek rageth
> Around Time's nurse,
> And *flickering flames*
> With heaven itself playeth.

The idea of "flickering flames" is original, or, at least, not borrowed from the Eastern poets, and, in my judgment, could only apply to the Aurora, it may be an extraordinary appearance of it; and as the Aurora, which has been seen in England this year, was also visible in India, I think it not at all unlikely that "a continual stream of fire," which "began to rain down," is a record of a similar extensive phenomenon.

Dec. 20 JOHN JERRMIAH

* Mallett's "Northern Antiquities" (Bohn's Edition, 1847, p. 455).

BALLOON ASCENTS FOR MILITARY PURPOSES

III.

THE laws of the motion of a balloon, dependent on the change of level, appear to have been hitherto very little discussed from a scientific point of view. It is, however, a motion which can be procured very easily by throwing out a small quantity of sand, or of gas, if the balloon is properly constructed, and which is of great importance for any expedition in time of war, more perhaps than even the attempt at guiding its direction. The number of minutes required for descending from a great altitude as well as for ascending to a certain level, being the most important consideration for the aëronaut endangered by the vicinity of some foreign force, this was analytically examined by M. Dupuy de Lome. It is the first instance that I know of such a disquisition since Euler worked his equations relating to the elevation of an aërostatic sphere supposed to be inextensible, and to be carried away in the atmosphere with a certain amount of motive power due to the small specific gravity of the included gas. That beautiful analytical disquisition is the last ever written by the old philosopher, who was totally blind at the time. It was found written by him on the *tableau noir* where he was making his calculations on the very day before he died. He had received the intelligence of the great experiment tried by Mongolfier, and his excited brain had produced during the night that masterly piece of mathematical skill which was unhappily his last! This contribution to scientific ballooning is to be found in the "Mémoires de l'Académie des Sciences de Paris" for 1781, a date anterior to the experiment of Mongolfier, which is accounted for by the issue of the volumes being always later than the date inscribed on them. Another singularity is that Euler speaks of gas for filling the balloon, while Mongolfier's was merely heated air. We must not, however, give Euler the merit of having been the real inventor of *Charlières* or gas balloon, as Mongolfier believed that he prepared gas by burning damp corn-straw! Before returning to the questions considered by Dupuy de Lome, we may be allowed to mention that the use of gas enclosed in a gasholder of any description, was suggested by Blake in his lectures at Edinburgh, and by an Italian philosopher transacting business in London. Carvalho tried to give to the idea of Blake the shape of an experiment, but uselessly, for the want of a proper varnish, which was invented by Charles a few months only after Mongolfier's great experiment.

The principal difficulty for strangers to the scientific working of an aërostat, appears to be to draw a broad line between the *motive power* or *force ascensionnelle*, and the *space* offered for free dilatation without any gas being lost in the air, which space I will call *the dilatation chamber*, although generally there is no

special balloon to allow for this, but the lower part of the balloon is left unfilled.

The *Géant* had a special balloon for this purpose attached to the bottom of the large one by a kind of short connecting tube of a very large diameter, and this balloon was called the *compensator*. The arrangement can be seen by the engravings showing the *Géant* in *aerial travels*.

If we suppose that we have at our disposal a balloon of india-rubber susceptible of any distension, we are in a position to assimilate the motion of our aërostat to the elevation of an *Atwood's Machine* moving upwards with a certain moving weight, without any other friction than that of the air. All the calculations and formulæ worked for that philosophical instrument can be used. a = the weight of the air replaced; b = the weight of the balloon including gas and everything; $\frac{a-b}{a}$ will be the motive power; the motion will take place according to the rule for accelerating powers in a medium where the pressure is diminishing, as is the case with the atmosphere when the balloon is ascending. If we pay no attention to the friction on the air, which is very small indeed when motion is slow, we have an acceleration of motion varying as t, and a height obtained varying as t^2, as is well known. If g' is the new motive power and g the motive power of the ordinary specific gravity, then $g' = g \times \frac{a-b}{a}$; $\frac{a-b}{a}$ remaining constant under the assumption we have given.

The best way to realise this assumption is to suppose that the balloon is partially empty when leaving the surface of the earth, and the assumption holds good as long as the balloon is not filled up by dilatation. The time taken by the dilatation to fill up the space allowed to it, regulates the level where the balloon can ascend without losing any of its motive power. This friction must be considerable in cases where the balloon is to be sent to a great distance from the earth. The chamber of dilatation must be chosen in proportion to that distance. At all events it must be calculated thus: R being the radius of the sphere $\frac{4}{3}\pi R^3$ is the maximum volume which the gas is able to take without escaping into the atmosphere, C being the weight of gas and Δ its gravity for each cubic metre $\left(\frac{4}{\pi}R^3 - \frac{C}{\Delta}\right)$ is the number of cubic metres which can be afforded for dilatation, S_0 H_0 being the actual pressure on the earth. The pressure can be diminished in the proportion $\frac{C}{\Delta}$ without the gas beginning to escape. If we call H_1 the altitude where this escape is to begin, we can write the equation $H_1 = H_0 \frac{\frac{C}{\Delta}}{\frac{4}{3}\pi R^3}$ To ascertain the actual value of the corresponding altitude, it is necessary to look at the empirical tables inserted in the *Annuaire du Bureau des Longitudes* of each year, and calculated for reckoning the altitude from actual barometric pressure. These tables were calculated by M. Mathieu on the assumption of the truthfulness of Laplace's equations given in his *Mécanique céleste;* but I suspect these assumptions are not sound, and may possibly mislead French aëronauts, while Prussians are watching them below ready to shell their balloon if it comes within range. But having instituted no direct measures for ascertaining the value of this law, aëronauts are obliged to make use of it. The calculations of M. Dupuy de Lome for carrying his intended balloon out of range suppose the truthfulness of the numbers of the *Bureau des Longitudes*. If in doing so aëronauts are not sure of escaping hostile bullets, they can at all events get rid of every analytical obstruction, which is certainly something.

When the escape begins, the motive power is not destroyed at once. It certainly diminishes at a very quick rate if the *appendix* is wide enough to give free issue to the gas, and the vertical motion is also rapid. If not there is some danger of explosion, as can easily be imagined. Generally aëronauts are very anxious to get rid of this danger, which can be done very easily by opening the escape valve. But this operation involves the aëronaut in a "sea of troubles," as the valve for discharging the gas is rendered gas-tight only by the application of a proper plaster. The only way of dealing rationally with that excess of gas is to have a proper vertical motion when the discharge begins. That condition is very easy to obtain if you start with a very small ascensional power indeed.

In the fraction $\frac{a-b}{a}$ is very small, and moreover if the fraction $\frac{C}{\Delta \frac{4}{3}\pi R^3}$ is large enough, you can conduct your balloon very safely at any distance if you do not meet with dark clouds, or burning sun. You can get rid very easily of these conditions by disposing cleverly of your ballast, as will be very easily understood by everybody after some explanation. There is however a circumstance which is very annoying in our military ascents, and on which it may not be useless to say a few words: the necessity of going at a certain level before reaching the meridian of the enemy's lines. The aëronaut is therefore obliged to know that distance and the quickness of the motion of the wind, so that the fraction $\frac{L}{V}$ gives the number of minutes at his disposal to reach the level required above that dangerous meridian. V = medium velocity of the wind, as obtained by balloons sent free into the air, S = elevation which the enemy's bullets cannot reach, I suppose it to be 6000 yards. Having no proper experiments at my disposal, I beg leave to make that gratuitous assumption. M. Dupuy de Lome, in his contribution, speaks only of 3000 metres, but Krupp's cannon was not in operation when he was writing. L = distance of enemy's lines from the workshop. It is of great importance to increase that distance as far as possible, and I advised the Government to take two starting stations, one from the northern bank to be used when the wind was blowing southerly, and one from the southern when the wind was blowing northerly, so that in every case aëronauts might cross the whole of our city. But the suggestion was disregarded. The solution adopted was to start in the night time! It is a singular mode, very unscientific, to solve an analytical problem by the sending of the aëronauts either to the great ocean to be drowned, or to Norway to be frozen. The subject is far from being exhausted, as to the re-bounding of the balloon according to the law of oscillatory motions. But fearing to extend my remarks to a length beyond the patience of my readers, I beg leave to end my contribution at this point, thanking the editor of NATURE for the hospitality exhibited towards a French aëronaut, and hoping to be more fully acquainted with the English scientific public on some future occasion.

W. DE FONVIELLE

SOCIETIES AND ACADEMIES

LONDON

Royal Society, Dec. 22.—"On the Constitution of the Solid Crust of the Earth." By the Ven. Archdeacon Pratt, M.A., F.R.S. In this paper the author applies the data furnished by the pendulum-observations recently made in India, to test the truth of the following hypothesis regarding the Constitution of the Earth's Crust, which he propounded in 1864, viz. that the variety we see in the elevation and depression of the earth's surface in mountains and plains and ocean-beds has arisen from the mass having contracted unequally in becoming solid from a fluid state; and that below the sea-level, under mountains and plains, there is a deficiency of matter, approximately equal in amount to the mass above the sea-level; and that below ocean-beds there is an excess of matter approximately equal to the deficiency in the ocean when compared with rock; so that the amount of matter in any vertical column drawn from the surface to a level surface below the crust is now, and ever has been, approximately the same in every part of the earth. In order to make this hypothesis the subject of calculation, the author takes the case of the attenuation of matter in the crust below mountains and plains, and the excess of matter below ocean-beds, to be *uniform*, to a depth m times the height above the sea-level or the depth of the ocean, as the case may be. The results are shown in the following Table, in which the numbers are the last figures in the ratio of the differences

of gravity to gravity itself, carried to seven places of decimals. The decimal point and ciphers are omitted for convenience.

Stations.	Differences of Gravity.			
	Relative effects of local attraction deduced from pendulum observations	Residual errors after correction by the method of		
		Dr. Young.	This Hypothesis.	
			$m = 50$.	$m = 109$.
Indian arc stations.				
Punnæ	—	—	—	—
Bangalore . . .	+384	−562	− 78	−557
Damargiæa . . .	−323	−926	−455	−584
Kalianpur . . .	+341	−208	+338	+315
Kaliana	−707	−957	+ 69	+320
Coast stations.				
Punnæ	—	—	—	—
Alleppy	+302	+314	+331	+360
Mangalore . . .	−166	−154	−122	− 79
Madras.	−197	−192	−138	− 78
Cocanada . . .	+142	+153	+216	+291
Ocean station.				
Minicoy Island.	+894	+906	+ 31	+102

The author points out from this table that Dr. Young's, or the usual method of correction for local attraction, so far from improving matters, introduces very large residual errors of the arc and ocean stations; and, at places on the arc of meridian, all lying on the same side with reference to Punnæ. He observes that neither the usual method nor his own much affects the coast-stations, and attributes this to the want of more complete knowledge of the contour of the surface, both above and below the sea-level, in these parts. But his own method, in the case $m = 50$, remarkably reduces the effects of local attraction at stations on the arc of meridian and out at sea (in Minicoy, an island 250 miles west of Cape Comorin or Punnæ); for the sensible negative quantity at Damargiæa and positive quantity at Kalianpur indicate a deficiency of matter below the first and an excess below the second—which exactly tally with the results independently brought out by relative deflections of the plumb-line as obtained by the survey; and the two large and most important effects, negative at Kaliana and positive at Minicoy, may be said to be almost annihilated by this method of correction. This last case of an *excess* of gravity out at sea (where the surrounding ocean has a deficiency of matter) being explained by his method, he regards as a very strong argument in its favour. And he finishes by saying that if his method is thus far successful in the particular supposition of the distribution below, whether in excess or defect, being *uniform*, which is most likely not strictly the case, there is every reason for concluding that pendulum-observations give support to the hypothesis regarding the constitution of the Earth's Crust, when viewed on a large scale, admitting of local peculiarities, like the deficiency of matter near Damargiæa and the excess near Kalianpur, and the similar deficiency near Bangalore.

"On the Extension of the Coal-fields beneath the Newer Formations of England; and the Succession of Physical Changes whereby the Coal-measures have been reduced to their present Dimensions." By Edward Hull, M.A., F.R.S., F.G.S., Director of the Geological Survey of Ireland. In this paper the author, embodying with his own the observations of previous writers on the physical geology of Great Britain, especially those of Murchison, Godwin-Austen, Ramsay, Phillips, and the late Professor Jukes, showed that the Coal-measures were originally distributed over large tracts of England, to the north and to the south of a central ridge or barrier of Old Silurian and Cambrian rocks, which stretched across the country from North Wales and Shropshire into the Eastern Counties, skirting the southern margin of the South Staffordshire Coal-field. This barrier, or ridge, was a land-surface till the close of the Carboniferous period. To the north of the central barrier, the highlands of Wales, the mountains of the Lake district, and probably small tracts of the southern uplands of Scotland, formed land-surfaces skirting portions of the Carboniferous area, while the Carboniferous tract to the south of the central barrier was probably bounded by a land-surface trending along the southern coast of England. The distribution of the Coal-measures at the close of the Carboniferous period was illustrated by a map. It was then shown that the whole Carboniferous area was subjected to disturbances through the agency of lateral forces, whereby the strata were thrown into folds along axes ranging (approximately) in east and west directions; and as denudation accompanied and followed these disturbances, and acted chiefly over the arches (or anticlinals), large tracts were divested of Upper Carboniferous strata, and thus the first phase in the marking out of the limits of our present coal-fields was brought about. The effects of these movements and denudations were illustrated by another map. The disturbances which ensued after the deposition of the Permian strata, and which produced the discordances of stratification between the newer Palæozoic and Mesozoic formations, were shown to have acted along lines ranging approximately north and south, parallel to the axis of the Pennine Chain, and consequently in a direction transverse to those of the previous period. These disturbances were also accompanied by the denudation of strata from off the anticlinal arches, and the consequent disseverance of the coal-measure tracts over certain definite areas. The results of these movements (the second phase in defining the bounds of the coal-fields) were illustrated by a third map. From a consideration of the foregoing observations, the author came to the conclusion that the tendency of the British coal-fields to arrange themselves into the form of "basins" (sometimes partially concealed by newer strata), a tendency strongly insisted on by Professor Ramsay, F.R.S., was due to the intersection of the two systems of flexures above described, one anterior to the Permian period, the other anterior to the Triassic period, and that the actual disseverance of the coal-fields into basins was due to denudation acting with greatest effect along the anticlinal arches of these flexures. The inference that the Yorkshire and Durham coal-fields are really basins rising to the eastward under the Mesozoic strata was drawn—an inference supported by the easterly rise of the coal-measures along the sea-coast from the Coquet to the Tyne. Guided by these principles, the author maintained that we were now in a position to determine with great accuracy the actual limits of the coal measures under the Mesozoic formations over the area to the north of the central barrier ridge, and that to the south of the ridge the application of the same principles would assist towards the solution of the question, though in a less degree, owing to the fewer opportunities for observation of the Palæozoic formations. The author, however, concurred in the views advanced by Sir R. I. Murchison,* that in consequence of the great amount of denudation which the carboniferous rocks had undergone over the area o the south of England previous to the deposition of the Mesozoic formations, little coal was to be expected to remain under the Cretaceous rocks.

Anthropological Society, December 20.—Dr. Charnock, V.P., in the chair. The following were elected Fellows, Mr. H. W. Bellew, Peshawur, India; Mr. F. Tagart, F.R.C.S.; and Mr. C. Cornish Brown. The Rev. W. W. La Barte, M.A., Local Secretary for Brighton. Mr. A. L. Lewis read a paper "On some Archaic Structures, principally Megalithic, in Cornwall and Devon, with remarks on their probable Uses." The author drew a comparison with similar monuments in other places, and illustrated the paper by the exhibition of models, from his own sketches and measurements, and by photographs. The structures described were, a circle called Dance Maen, two circles both called "Nine Maidens," three circles together called the "Hurlers," all in Cornwall; and one on Dartmoor, Devon, all which the author believed to have been used for sacrifice, and compared with some so used in India; "Chun Quoit," a sepulchral dolmen; "Lanyon Quoit;" "the Spinster," Devon; "the Trevethas Stone," Cornwall, used for sacrifice; the "Men-an-Tol," Cornwall, a monument of perhaps a phallic character, and the ancient towns called Chun Castle, Cornwall, and Grimspound, Devon.—Dr. Henry Muirhead contributed some remarks on the Difficulties of the Theory of Natural Selection. The opinions of Mr. A. R. Wallace on the subject were criticised; and the term "survival of the fortunate" suggested for that of "survival

* In his address at the meeting of the British Association at Nottingham, 1866. On the other hand, the views of Mr. R. Godwin-Austen, F.R.S., which tend rather in an opposite direction, should be well weighed by all who are interested in this question.—*Quart. Journ. Geol. Soc.* vol.

of the fittest," adopted by Mr. Wallace from Mr. Herbert Spencer. The subject of individual variation was discussed at some length, and the laws of divergence commented on. The author expressed his dissent from Mr. Wallace's interpretation of Darwin's theory.

Mathematical Society, Dec. 8.—Mr. W. Spottiswoode, F.R.S., president, in the chair. Mr. J. Hamblin Smith, M.A., of Caius College, Cambridge, was elected a member.—Prof. H. J. S. Smith made a communication on the subject of Elliptic Integrals.—Prof. Cayley read a note on his former paper, "On the Theory of the Rational Transformation between two Planes, and on Special Systems of Points," followed by an account of an addendum to his recent memoir on "Quartic Surfaces." In this latter communication he stated the following theorem:—Take any seven points; an eighth point at pleasure on the dianodal surface of the seven points; a ninth point at pleasure on the dianodal curve of the eight points. In the system of nine points so determined take any one as vertex, and joining it with the remaining eight, construct the ninth line of the "ennead": we have thus nine lines passing through the nine points respectively. These nine lines meet in a point which is the "enneadic centre" of the nine points; and further, the ten points form a completely symmetrical system, so that each one of them is the enneadic centre of the remaining nine. [The name "ennead" is given to any nine points *in plano*, which are the intersections of two cubic curves, or to any nine lines through a point which are the intersections of two cubic curves; the ten points in space are such that taking any one whatsoever as vertex, and joining it with the remaining points, the nine lines form an ennead.] The author stated the following system of correspondence as a subject for investigation—viz., given any eight points in space; then to every point in space corresponds a line through this point, viz., the ninth line of the ennead obtained by joining the point with the eight given points respectively; and to each line in space a point or points on the line, viz., the point or points for each of which the line is the ninth line of the ennead obtained by joining the point with the eight given points respectively.—Dr. Hirst entered at some length into an explanation of the methods employed in his paper "on the Polar Correlation of two planes, and its connection with their Quadric correspondence." Profs. Cayley, Smith, Mr. Cotterill, and the author took part in a discussion on the paper.—Prof. Henrici exhibited a large model of Dr. Sylvester's amphigenous surface, which has for its equation

$$JK^4 + 8LK^3 - 2J^2LK^2 - 72JL^2K - 432L^3 + J^3L^2 = 0$$

where $$K = \frac{D - J^2}{128}$$

The equation of the surface is obtained by substituting $x = 1024\,L$, $y = \frac{3}{2}\,D$, $z = 6\,J$ and taking x, y, z as rectangular cördinates. The unit was taken $= \frac{1}{2}$ of an inch. The sections parallel to the axes of cördinates are unicursal curves. Thus the cördinates x, y, may be expressed and terms of z and a parameter ϕ:—

$$x = \tfrac{1}{24}\,\frac{1}{\phi^3(\phi + 1)}\,z^3$$

$$y = \tfrac{1}{24}\left(\frac{\phi + 2}{\phi}\right)^2 \frac{\phi - 3}{\phi + 1}\,z^2$$

The surface is of the ninth order, and has two cusp lines. The one is a common parabola in the plane $L = 0$, and has the equation $K = 0$ or $D = J^2$. It is of the second species, that is to say, any plane section of the surface possesses a cusp of the second species where it cuts it. The second is a common cusp line. It is a curve of double curvature of the third order, and has the equations

$$27\,L = -\,J^3;\quad 3\,D = -\,125\,J^2$$

thus the projections on the three axes are a common parabola, a semi-cubic and a cubic parabola respectively. Both cusp lines ouch one another at the origin, where the axis of J is a common tangent; thus the origin is a triple point, as appears also from the equation. The surface divides the whole space into two congruent parts. If we turn the surface through an angle of 180° about the axis of D, which is altogether on the surface, one half will take the original position of the other. The plane $D = 0$ touches the surface along a curve $2048\,L = J^3$, and divides each half of the space, separated by the surface, into three distinct parts. It is this property, which connects the surface in so remarkable a manner with the theory of binary quintics, and by aid of which Dr. Sylvester has shown (Phil. Trans. Part iii. 1864) how to decide whether the roots of an equation of the fifth degree are real or imaginary.

BERLIN

German Chemical Society, November 14.—Alex. Müller reported on the determination of very minute quantities of sulphuric acid in water. His method requires but small quantities of water, and consists in adding to it a weighed quantity of chloride of barium and an equivalent proportion of chromic acid. For every equivalent of sulphuric acid present in the water, one equivalent of chromic acid remains free, and can be determined by colorimetric comparison. He was thus enabled to determine one milligramme of sulphuric acid in fifty grammes of water.—Messrs. Emmerling and Engler have prepared phenyl-methyl-aceton: $C_6H_5\text{-}CO\text{-}CH_3$ by distilling together benzoate and acetate of lime. Nitric acid converts this body into two isomeric nitro-compounds of the formula $C_6H_4(NO_2)\text{-}CO\text{-}CH_3$, one of which is crystalline and the other a liquid. These compounds have acquired an unusual interest in the hands of Emmerling and Engler, serving as they have done for the first artificial formation of indigo blue. Indigo blue having the composition C_8H_5NO, the nitro-compound mentioned $C_8H_7NO_3$ has to lose H_2O and O to yield C_8H_5NO. This it does under the influence of soda and powdered zinc. The transformation is somewhat analogous to the reaction lately described by Baeyer, by which nitrocinnamic acid, $C_9H_7NO_4$, submitted to the action of powdered zinc, loses CO_2 and O_2, and forms indol, C_8H_7N. It appears that two molecules of nitro-phenyl-methyl-aceton enter into the reaction, and that the formula of indigo blue ought to be doubled, thus:

$$\begin{matrix} C_6H_4.CO.CH[H_2] \\ N[O_2] \end{matrix} = [H_2]\,HC.CO.H_4C_6 \begin{matrix} \\ [O_2]N \end{matrix}$$

The elements put in brackets are those eliminated in the reaction, by which apparently the nitro-groups are converted into azo-groups. Nascent hydrogen transforms the azo-groups into the hydrazo-groups, that is to say, the artificial indigo-blue into indigo-white. The latter reaction has been employed to identify the artificial with the natural product.—L. Henry indicated a practical way of forming iodate of potassium, by treating the corresponding chlorate with protochloride of iodine: $KClO_3 + ICl$ gives $KIO_3 + Cl_2$.—Dittmar and Kékulé have prepared a glycolic acid of the aromatic series. Cymol from camphor was converted into toluylic acid, then into bromotoluylic acid, and by the action of baryta water into oxytoluylic acid $C_6H_4\begin{matrix}CH_2OH\\CO\,OH\end{matrix}$—E. Erlenmeyer has studied the action of cyanamide on the hydrochlorides of compound ammonias, particularly of methylamine. He has thus produced methyl-guanidine, hitherto called methyluramine, and obtained by oxydising kreatine. It appears that crystallographic differences exist between the platinum salts of the artificial and of the natural compound. The same chemist has found that ordinary butylic alcohol yields isobutylic and acetic, but not propionic acid. He likewise communicated researches on the differences of the various valerianic acids.—A. Lieben communicated his views on the formation of chloral-alcoholate, thinking that trichlorinated acetal precedes the formation of the above compound.—A. Bunge reported on the electrolysis of some sulphur compounds.—C. Lieberman has investigated the substance described some years ago by Roussin under the incorrect name of artificial alizarine. It is formed by gradually adding nitro-naphthaline and zinc to sulphuric acid previously heated to 200°. Brown crystals are thus separated, giving colours with alkalies of a different hue from those produced by alizarine, and showing the composition $C_{10}H_6O_4$. It appears to be binoxynaphthochinone, and to stand in the same relation to naphthaline in which alizarine stands to anthracene. He calls the substance naphthazarine; the colours it gives are of no practical interest.—C. Vogel reported on the practical production of oxygen and of hydrogen by the New York Oxygen Gas Company. This company prepared in the month of August 20,000 cubic feet of oxygen a day at the price of five cents a cubic foot. The gas is pressed into copper reservoirs under a pressure of ten atmospheres, and largely used for laboratory and medical purposes, but chiefly for hydro-oxygen lamps in bridge-building under the surface of rivers. In lecture rooms also this kind of illumination is largely used to procure enlarged views of small photographs or drawings made on gelatine. The process for making oxygen is that first used by Jessie du Mothay. Iron

retorts are filled with 900 lbs. of a mixture of peroxide of manganese and caustic potash. A current of air passed through the retorts heated to 450°, transforms their contents into manganate. A current of steam is then passed through which sets the oxygen free and leaves a residue of sesquioxide of manganese and caustic potash. These processes may be repeated innumerable times. Hydrogen, together with carbonic acid, is produced on a smaller scale by heating to redness retorts filled with anthracite and hydrate of lime, for fifteen minutes. Afterwards steam is passed through to reproduce hydrate of lime. The same mixture can thus be used for three weeks. The hydrogen is sold at two cents a cubic foot in copper reservoirs holding sixty gallons similar to those described above, which are sold by the company at about eighteen shillings a piece. The sale amounted in August only to 2,000 cubic feet a day, as coal gas is generally used in preference to hydrogen.

November 28.—C. Rammnelsburg reported on the composition of tantalites and niobides. — A. Müller described a furnace for organic analysis.—Fr. Mohr in a lengthy paper tried to refute the laws of Avogadro and all modern theories in general. The same communicated his views on the connection of the conducting power for heat and the molecular movements of gases.—J. Thomson has determined the heat of combustion of hydrogen equal to 340·00. This number stands between those found by Andrews (338·00) and by Farne and Silbermann (344.00). He has also determined the quantity of water yielded by the combination of two litres of hydrogen, and found a number closely coinciding with that given by Stas. The same chemist described an apparatus for showing the combustion of oxygen in an atmosphere of hydrogen and a mode of exhibiting the alternate reduction and combustion of copper.—C. Bender has analysed some combinations of the hydrate and the chloride of magnesium.

VIENNA

I. R. Geological Institute, November 22.—Fr. von Hauer delivered the anniversary address, with a report on the progress made by the Geological Survey during the past year.—Baron Const. Beust gave a description of the layers of zinc and lead ores on the Schneeberg, in Tyrol. Although known for a long time, their real value has never been appreciated. The parts of the bed at present opened contain, after a moderate deduction, ores to the value of more than eighty million florins (eight million sterling). All measures are being taken for an extensive investigation.—M. F. von Hochstetter exhibited miniature volcanoes formed by sulphur in a soda manufactory. Sulphur melted in water under a steam-pressure of two to three atmospheres combines with a certain quantity of water. Larger masses of this melted sulphur (one to two quintals) were poured in conveniently deep wooden vessels. In consequence of the refrigeration, a crust was soon formed on the surface. In this crust a hole was kept open, through which, as the congelation of the sulphur proceeded, periodical eruptions of melted sulphur, together with exhalations and explosions of steam, were observed. After the lapse of an hour and a half, a miniature volcanic cone was formed, with all the characters of a volcano formed by successive lava streams. Observations which can be made during this experiment are sufficient to explain and to confirm many facts observed in real volcanoes. If the artificial eruption is interrupted by a second hole made in the crust, the cone becomes hollow, and if this hollow cone is crushed and the eruption again caused by closing the second hole, a model is formed of a younger volcanic cone which is surrounded by an outer barrier, like Vesuvius or the Peak of Teneriffe. If the process is conducted to the end without interruption, the result is a massive cone with a closed crater, which resembles perfectly the homogeneous dome-volcanoes, as Seebach calls them. These domes, or massive cones, must therefore be considered as the inner massive nuclei of perfectly extinct volcanoes, the lava, ashes, and tuffs of which have been removed by denudation.

BENGAL

Asiatic Society, September 7.—The Hon. J. B. Phear, President, in the chair. "The Vástu Yága and its bearings upon Tree and Serpent-worship in India," by Babu Pratápachandra Ghosha, B.A. The Vástu Yága and various other forms of Serpent and Tree-worship are traceable as much to a feeling of fear as to other causes. It is evidently a sacrifice, invented by the ancient Aryan conquerors with a view to propitiate the aborigines or primeval owners of the land. Vástu is the principal god, and though the aborigines themselves are not worshipped by name, the Nága is no doubt the ostensible object of worship. The several gods, properly *pitris* (ancestors, predecessors, former owners) that occupy the several *mandalas*, are also the names of Nágas. The Vástu is the God Earth, quite distinct from Dharâ (Terra) and in the prayer he is represented as the supporter of the world. The Vástu Yága, therefore, appears to be a memorial of the foundation of the new Aryan home and of the Nágas, a powerful race of aborigines. In the ceremony for dedicating a tank, a stick is planted on its banks. This stick is the *Nága-yashti*, or the Nága-pole. The application of the term Nága to the reptile class is without doubt of comparatively recent date, and since that time may be noted the double meaning of the word applied to the Nága aborigines as well as to the Nága serpents. Ananta is worshipped not as a snake, but as a form of Vishnu. It literally means eternity. The *Anantacha-turdas'i*, *Nágapanchami*, and such other minor vratas, though connected with the Nágas, have nothing to do with the actual reptile. The aborigines of India bore a peculiar relationship to the first Aryan settlers. Many of the aborigines were held in high estimation, and in a legend the goddess Sarasvati is described as imparting the art of music to two of the Nágas (*Kamvala* and *As'vatara*), and the name of Karkotaka, another Nága, is enjoined to be uttered every morning, There are again several fruits, trees, and things which are named after the Nágas, and these are all derived from the N.E. frontiers of India. From the above, it would appear that the Nágas as a race of powerful aborigines were respected for their prowess and also hated for their barbarous habits. The eminent among them were soon identified with some Hindu gods, and ultimately the Nágas, as a race, became a class of gods. Serpent-worship, in the true sense of a creature-worship, was never prevalent in India, and though, under peculiar circumstances, this worship may be seen at the present day among the several hill tribes, still such a practice does not obtain among the Aryans. The serpent, as an emblem of eternity, is respected, but it is the worship of Vishnu and not of the reptile. Serpents have crept into our mythological legends, but in whatever form they appear, they are put down as enemies of Vishnu. Ráhu is darkness, and its stellar form is a snake. Sun = Hari = Vishnu, the destroyer of Ráhu, the first destroys as darkness, the second as snake, and the third as death. Figures of Nágas occur in sculptured stones, but only for ornamentation. Several trees are described in later Puránas as forms of Vishnu and other gods, but they are cherished with a degree of care because of their extreme usefulness in the tropical country. For instance, *Tulsi* as an aromatic herb, the *Durva* as a fodder on which the cattle live, the religious fig-tree as offering cool shelter, the cocoa-nut as a refreshing fruit. Some trees again are noted as obnoxious when planted near dwelling houses, because in a Hindu hygienic point of view, they are considered injurious to health. The papaya plant is one of those that no Hindu would like to have near his house.

PHILADELPHIA

Academy of Natural Sciences, Sept. 6. — Mr. Vaux, Vice-president, in the chair.

Sept. 27.—The President, Dr. Ruschenberger, in the chair.—"On the Flowers of *Aralia spinosa* L. and *Hedera Helix*, L." by Thomas Meehan. The study of *Aralia spinosa* L. affords some interesting facts which do not seem to have attracted the attention of other observers. In Dr. Gray's indispensable "Manual of Botany," it is said to be "more or less polygamous." I have had many specimens under my daily observation this season, from the earliest opening till the last blossom appeared, and find that it is much more nearly monœcious than the above quotation would imply. There are three different sets of flowers corresponding to the thrice compounded branchlets of the large panicle. When the flower scape elongates, it seems suddenly arrested at a given point, and a very strong umbel of *female* flowers appears at the apex. A great number of secondary branches appear along this main one; and they also suddenly terminate each with an umbel of female flowers. From these secondary branches a third series appears, and these flowers are well filled with anthers that are abundantly polleniferous. The female organs of these flowers of the third class are, however, defective, as only a few bear capsules, and in these, a large portion of the seeds have no ovules. The polygamous character is confined to this third series of flower, the first two having purely pistillate blossoms. In these there do not seem to be the rudiments of stamens. The most remarkable part of this process of development is, that the whole of this first series of female flowers should open so long before the male ones come,

that they fall unfertilised. The greater part of the second series also fall, and the crop of seeds is mainly made up of a few of the last opening ones of the series, and the comparatively few hermaphrodite ones which are found in those of the third class. It is a matter for curious speculation what special benefit it can be to the plant to spend so much force on the production of female flowers too early to mature, and then producing such an immense mass of pollen to go utterly to waste. Examining the flowers of the allied European evergreen ivy, *Hedera Helix* L., I find similar laws of distribution of the sexes as in *Aralia spinosa*, with the addition of a somewhat different structure in the male from the female flowers. In Europe the plant is described as often having a single umbel as a flower spike. It is quite likely in these cases that the flowers are hermaphrodite. In all the cases I have met with here, the inflorescence is a compound of several umbels—a terminal one female, and the lateral ones male, as in *Aralia*. But there are rudiments of stamens in the flower, and in occasional instances I find a filament developed; but never, so far, with any pollen-iferous anthers. The flowers of the central female umbel have rather longer and stronger pedicels than the lateral male ones. The calyx is united with the ovarium for one-half its length, and the latter much developed in the unopened flower. In the male the segments of the calyx are two-thirds free, and the petals are much longer than in the female flowers. As in *Aralia spinosa*, the male flowers do not open until some time after the female ones; and not before some of the latter, impatient of delay, have fallen unfertilised. I have so often and in so many varied ways demonstrated to the Academy that in plants the male element is a later and inferior creation, that it seems almost supererogatory to point out that these plants illustrate the same principle.

October 4.—Prof. Leidy made the following communications in palæontology. He directed attention to a collection of fossils from Sweet Water River, Wyoming Territory, recently received as part of the results of the geological exploration of Prof. Hayden. The most numerous and characteristic remains are those of a species of *Merycochærus*, about two-thirds the size of *M. proprius*, from the head-waters of the Niolorara river. The species was named *M. rusticus*. Other remains found in association with the former are referable to a species of *Hipparion*, to *Canis vafer* and *Merycodus necatus*. Two additional fossils, from a tertiary deposit near Fort Bridger, are referable to a small species of *Lophiodon*, which was named *L. modestus*, and a small suilline pachyderm, which was named *Hyopsodus paulus*.

October 18.—Prof. Leidy directed attention to a collection of fossils received from the Smithsonian Institution, from Rev. Thomas Condon, of Dalles City, Oregon. The specimens were obtained from a tertiary deposit in the valley of Bridge Creek, a tributary of John Day's River, Oregon. The greater number and more striking remains belong to a species of *Oreodon* larger than any previously discovered. The skull is about fourteen inches in length, and is intermediate in character to that of *O. major* and *Merycochærus proprius*. The species was named *Oreodon superbus*. Among other remains of the collection are those of *Oreodon Culbertsoni*, *Agriochærus antiquus*, *Leptomeryx Evansi*, and *Anchitherium Bairdi*. A fragment of an upper jaw with two true molars probably belongs to *Lophiodon occidentalis*. Other fossils indicate ten species of *Rhinoceros*, probably *R. occidentalis* and *R. hesperius*. Others probably indicate *Elotherium superbum* and *E. ingens*. A small fragment of an upper jaw with a molar tooth apparently indicates a larger species than *Anchitherium Bairdi*, and was referred to a species with the name of *A. Condoni*.

October 25.—Prof. Leidy stated that he had recently received several boxes of fossils collected during Prof. Hayden's expedition in Wyoming Territory. Among the mammalian remains are those of a pachyderm about the size of an ox, and related to the *Chalicotherium* and *Titanotherium*. These were referred to a species with the name of *Palæosyops paludosus*. A fragment of a lower jaw, with true molars like those of the peccary, but with pointed lobes, was referred to a species with the name of *Microsus cuspidatus*. The animal was about the size of a rabbit. The remains of a lower jaw of an ursine animal, about the size of a raccoon, was referred to a species with the name of *Notharctus tenebrosus*.

November 1.—Prof. Leidy exhibited the tooth of a mosasauroid reptile from the miocene tertiary deposit of Gay Head, Martha's Vineyard. From the peculiar minutely-lettered appearance of the enamel, the tooth was referred to a species with the name of *Graphiodon vinearius*. He also referred to a now extinct species of crocodile, indicated by portions of a skull collected in Prof. Hayden's expedition, from a tertiary deposit of Big Sandy River, Wyoming. The skull, when perfect, measured eighteen inches long. It has nearly the form of that of *Crocodilus vulgaris*. The upper jaw is deeply indented back of the fourth tooth, and a pair of deep pits occupy the front of the palate. The species was named *Crocodilus Elliotti*.

BOOKS RECEIVED

ENGLISH.—The Truth of the Bible: B. W. Savile (Longmans).—Physical Geography: Mary Somerville, new edition (Murray).—Voyage round the World, 2 vols.: Marquis de Beauvoir (Murray).—Natural History of the Azores: F. C. Godman (Van Voorst).—New Zealand and the South-Sea Islands: Capt. Meade (Murray)—Body and Mind: H. Maudsley, M.D. (Macmillan).—A Manual of Zoology: H. A. Nicholson, M.D. (Blackwood).

FOREIGN.—(Through Williams and Norgate)—Plantarum novarum Fasc. 1 H. Van Heurck.—Synonymia botanica, 1te Hälfte: Dr L. Pfeiffer.—Lehrbuch der Chemie, 1te Lieferung: Dr. G. F. von Gorup-Besanez.—Die Beziehungen zwischen dem Atomgewichte und der Natur der chemischen Elemente: Dr. H. Baumhauer.

DIARY

THURSDAY, DECEMBER 29.

ROYAL INSTITUTION, at 3.—Burning and Unburning: Prof. Odling (juvenile lectures).

SATURDAY, DECEMBER 31.

ROYAL INSTITUTION, at 3.—Burning and Unburning: Prof. Odling.

MONDAY, JANUARY 2, 1871.

ENTOMOLOGICAL SOCIETY, at 7.

TUESDAY, JANUARY 3.

ROYAL INSTITUTION, at 3.—Burning and Unburning: Prof. Odling.
ZOOLOGICAL SOCIETY, at 9.—Notes on the breeding-places of *Steatornis caripensis*: Hon. A. Gordon.—Descriptions of thirty-four new species of Shells from Australia: Mr. George French Angas.
ANTHROPOLOGICAL SOCIETY, at 8.—The Manx of the Isle of Man: Dr. Richard King.—The Anthropology of Lancashire; Dr. Beddoe, Pres. A.S.L.—On Forms of Ancient Interment in Antrim: Dr. Sinclair Holden.

THURSDAY, JANUARY 5.

ROYAL INSTITUTION, at 3.—Burning and Unburning: Prof. Odling.

CONTENTS